



Common AV & Payload
CSCI
Top Level Design

Section 7



Agenda

- PDR Part I Review
- Operational Model
- Top Level Design
 - Section 1: CSCIs Overview
 - Section 2: DCM CSCIs
 - Section 3: RTP CSCI
 - Section 4: DataServer CSCI
 - Section 5: DII CSCI
 - Section 6: Route & Payload Planner CSCI
 - Section 7: Common AV & Payload CSCI



CAP CSCI

Review
Implementation Approach
CAP Structure
Top Level Design
Detailed Discussion
Payload Display
AVO HUD



CAP CSCI Part I Review



Common AV & Payload CSCI

- Description

- The TCS will be in an open architecture and be capable of being hosted on computers that are typically supported by the using Service. [ORD003]
- The software will provide a high resolution, computer generated, graphics user interface that enables a UAV operator that is trained on one system to control different types of UAVs or UAV payloads with minimal additional training. [ORD002]
- The software developed will be Defense Information Infrastructure/Common Operating Environment (DII-COE) compliant, ...
- The initial core of software will be generically written to provide Level Five interaction for both TUAV and MAE UAVs and establish the architecture for future tactical UAVs. [ORD013]
- Since not all recipients of UAV information require all levels of TCS capabilities, the software, and software related hardware, if required, will be developed so that it is scaleable to meet users' needs. [ORD014]



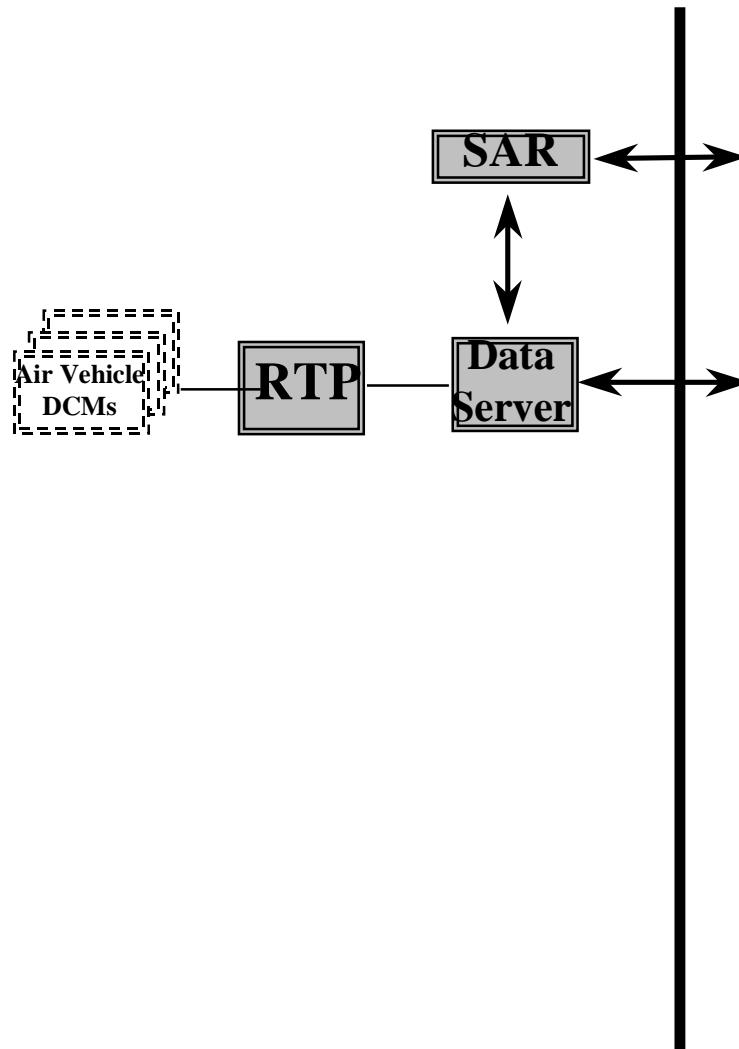
Requirements Break Down

| | TCS_Main | | | | | | | | | | | | | | |
|--------|----------------------|--------------------------------|-------------------------------|--------------------------------------|----------------------|------------|-------------------------------|------------------------|------------------------------|-------------------|--------------|--------|----------|-------------------|-------------------------|
| | AV Flight Monitoring | AV Flight Monitoring; Extended | EOIR Imagery Viewer & Capture | Imagery Processing & Data Extraction | EOIR Payload Control | AV Control | DataLink Management & Control | Tactical Data/Messages | Collection Tasking/Retasking | AV Schemas Update | System Setup | UIM-GE | Training | Launch & Recovery | Misc. Utilities & Tools |
| EB1 | 4 | 5 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 4 |
| EB2 | 1 | 4 | 1 | 8 | 6 | 1 | 2 | 0 | 11 | 0 | 0 | 8 | 0 | 0 | 6 |
| EB3 | 0 | 0 | 0 | 5 | 12 | 9 | 0 | 6 | 2 | 0 | 0 | 12 | 0 | 0 | 3 |
| EB4 | 1 | 2 | 17 | 6 | 2 | 9 | 39 | 12 | 1 | 0 | 0 | 67 | 2 | 0 | 18 |
| EB5 | 4 | 0 | 2 | 2 | 7 | 6 | 10 | 5 | 0 | 0 | 2 | 9 | 20 | 1 | 27 |
| Total: | 10 | 11 | 22 | 23 | 27 | 25 | 51 | 23 | 16 | 0 | 2 | 10 | 113 | 3 | 39 |

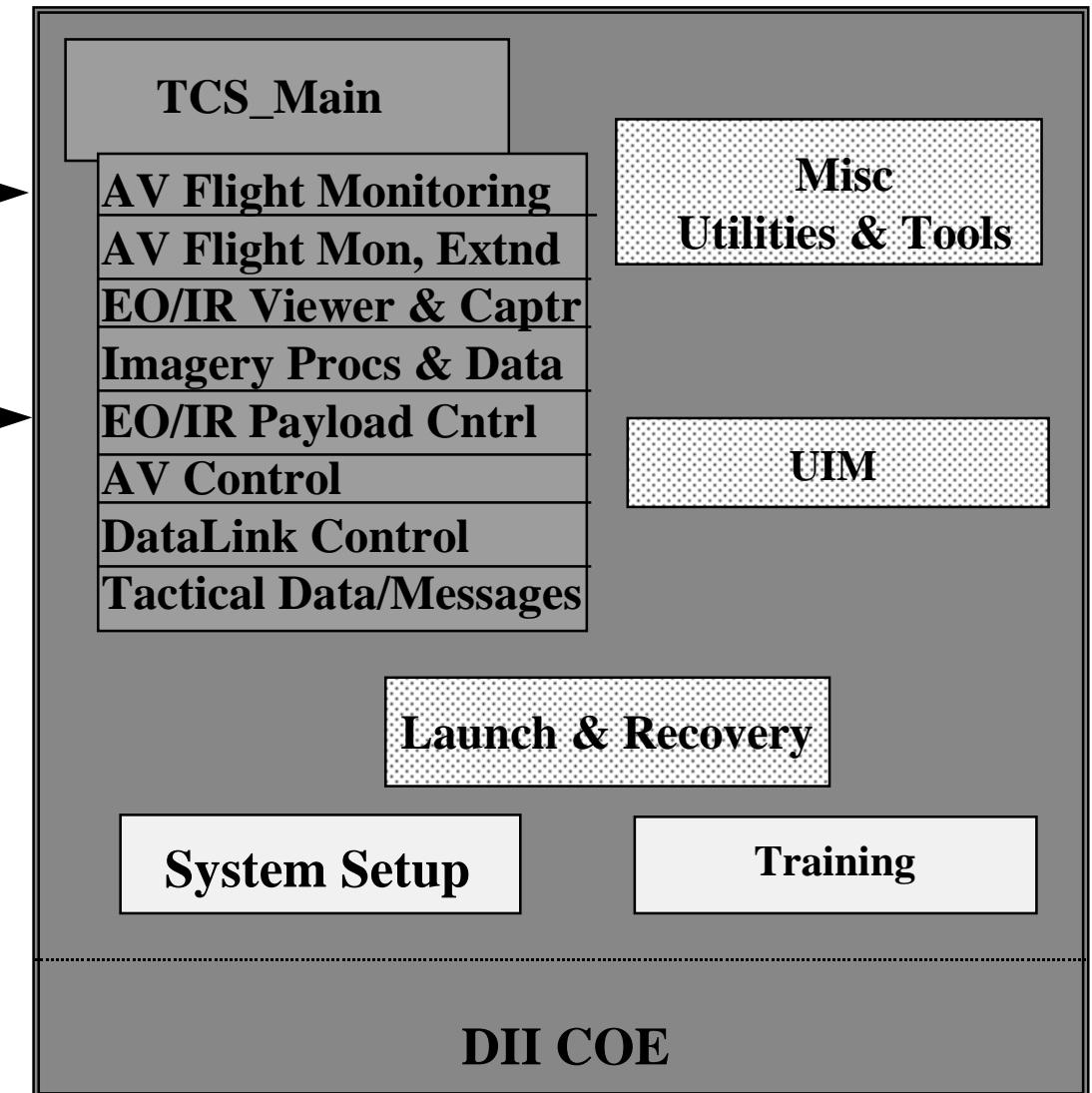


CAP CSCs

Real Time Functions



Non-Real Time Functions





CAP CSCs

- TCS_Main
 - Responsible for general startup, dynamic loading, execution, & termination of CSCs
- User Interface Manager
 - Responsible for all HCI Displays
 - Operator entry screens, HUD displays, etc.
- Misc Utilities & Tools
 - Network I/O, File I/O, Test Drivers, etc.
- AV Flight Monitoring
 - AV status data
 - Data Link status data
 - Graphical display of AV-Icon, flight route, payload swath, GDT
- AV Flight Monitoring, Extended
 - Detailed AV Status data
 - AV Alerts and Warnings Messages



CAP CSCs (Continued)

- EO/IR Imagery Viewer & Capture
 - NTSC viewing via a video board
 - Display of downlink data and Image geo-position data
 - Video image capture
 - NITF 2.0 format
- EO/IR Payload Control
 - Operator commands for controlling payloads
 - Course control via virtual stick
 - Fine commands payloads
 - Stick control of the payload
- Imagery Processing and Data Extraction
 - Display NITF 2.0 images and header and support data elements as applicable
 - Allow operator annotation of images with annotation data store in proper CGM format
 - Allows operator to designate targets for generation of tactical data/picture
- Tactical Data/Messages
 - Generate track/target data for DII's Tactical Picture
 - Generate tactical messages for output to C4I systems base upon identified tracks/targets



CAP CSCS (Continued)

- AV Control
 - Route Plan data upload to AV
 - “Fly to Destination” commands
 - General AV commands for auxiliary systems such as
 - Lights, IFF, etc
 - Stick commands for DCMs for AV flight control
 - Emergency Operation Commands
- DataLink Control
 - Operator commands for controlling the datalink
 - ON/OFF, RF Channel, RF Power, etc.
- Training
 - Responsible of all user help and training aids
- Launch & Recovery
 - Adds additional functionality to AV Control CSC for launch & recovery of UAV
- System Setup
 - Responsible for system setup information
 - Network configuration data, system/hardware configuration data, etc.



CSCI Implementation Approach

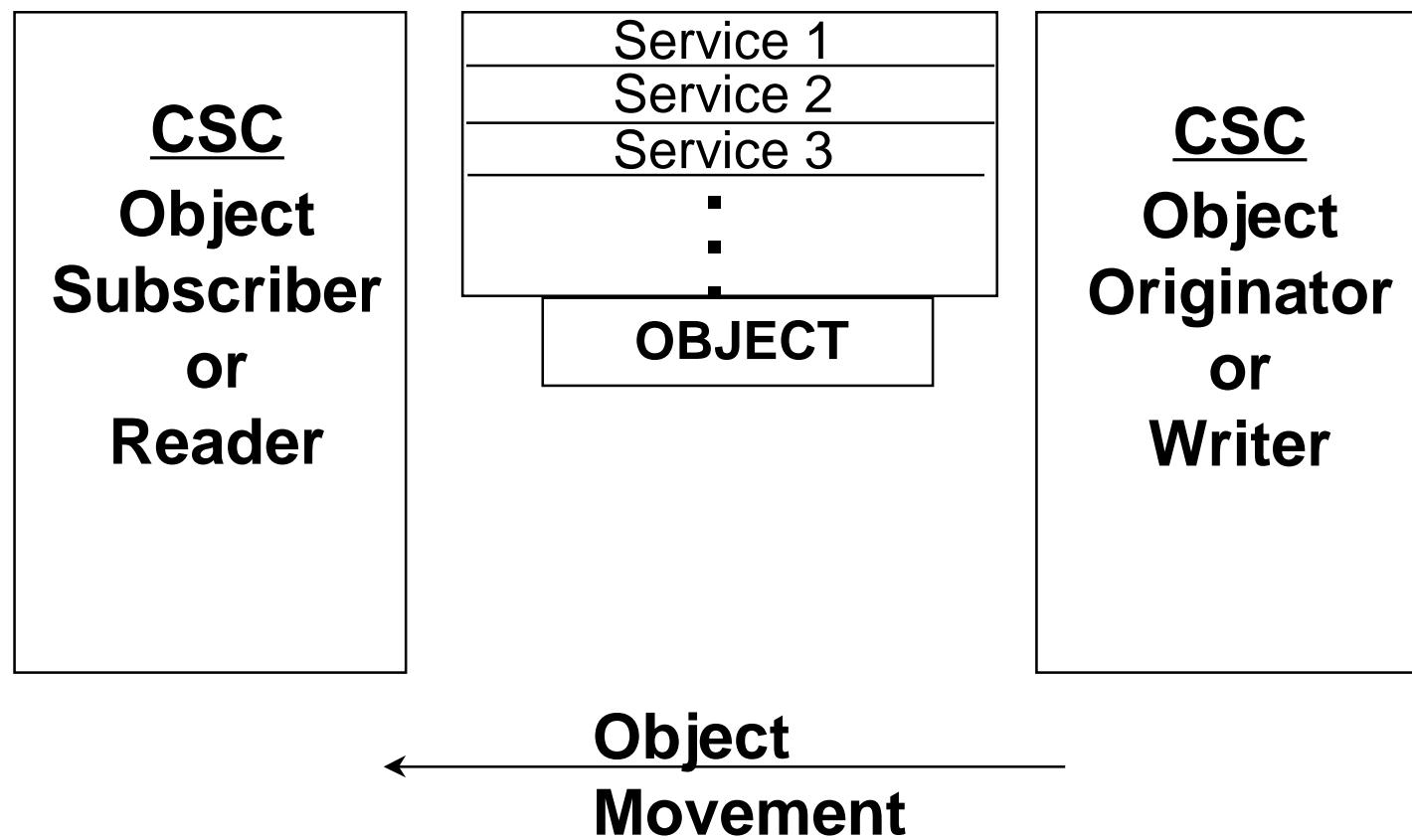


Implementation Approach

- Object Oriented Design
 - DS Objects
 - UIM Objects
- AV & Payload CSCs written in Ada95
- UIM written in a combination of Ada95, C, & Tcl
 - UIM API; Ada95
 - GE, Vicap, HUD, & Chart front end written in C
 - X Windows objects written in Tcl/Tk
- Setup CSC written in Tcl/Tk

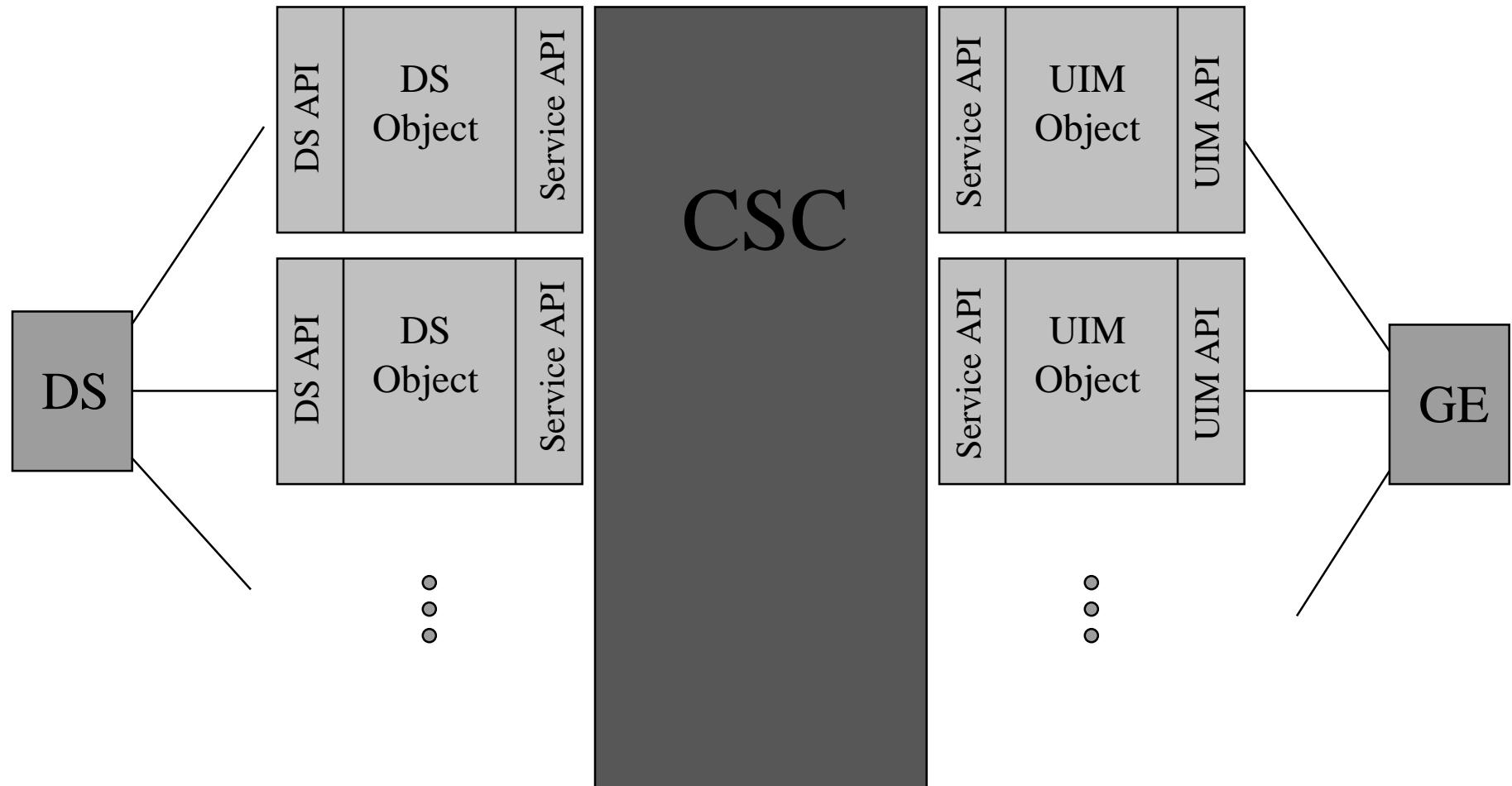


Conceptual Object Model





Object Model



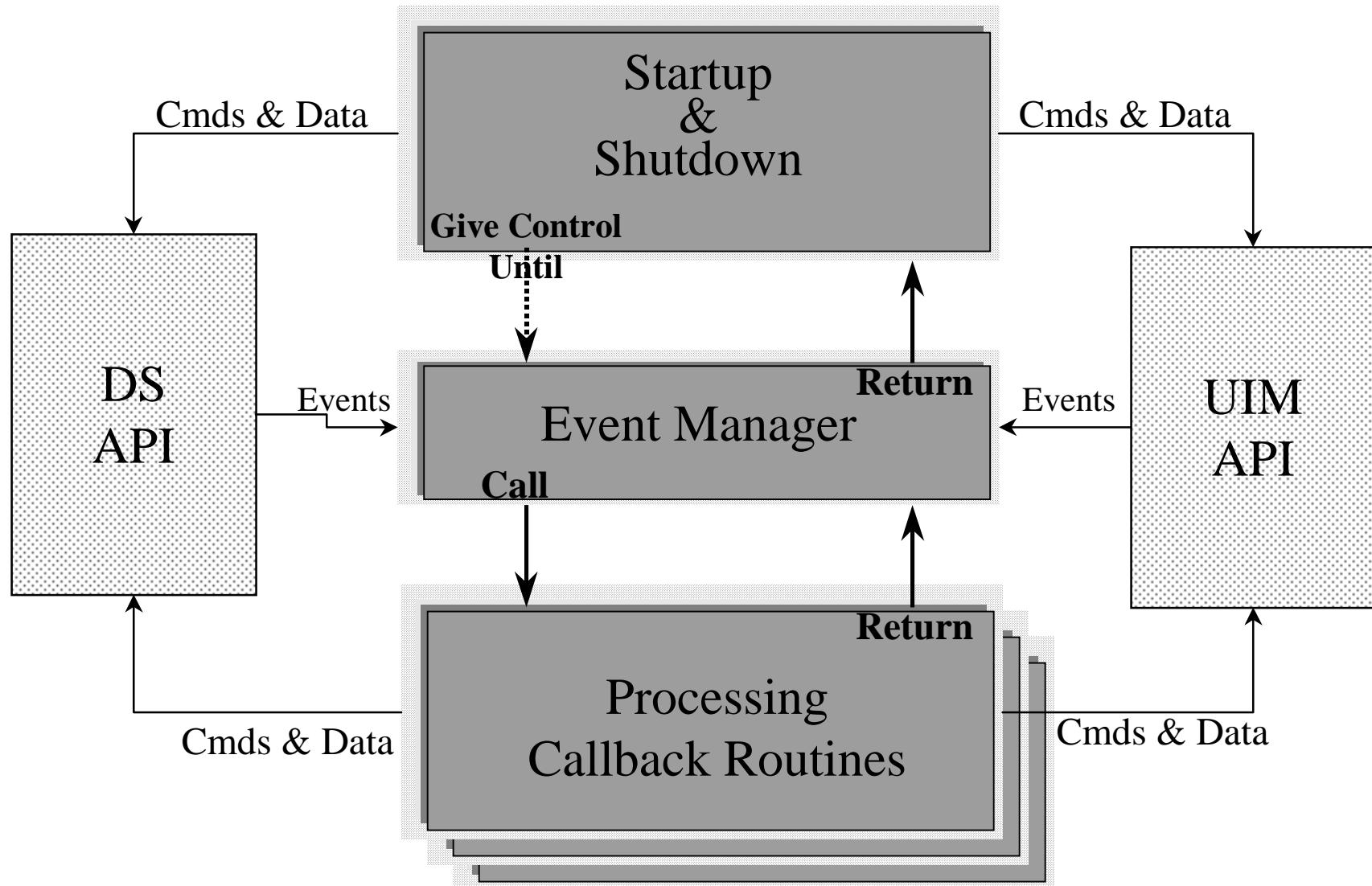


Event Based Design

- The design of all CSCs is based upon an event driven, asynchronous processing model
 - Events are a continuous stream of input which triggers processing to handle the event
 - Downlink data from the DCMs
 - Input data, mouse clicks, etc. from the operator
 - One event can trigger other events
 - New AV Position data requires the updating of several UIM Objects



Event Model





CSCs Startup

- Based upon Role(s)
 - Load dependent CSCs
- Perform initialization as required
 - Issue create cmds for DS and/or UIM objects
- Register callback routines for events from object
- Wait for events
 - Give control to Event Manager

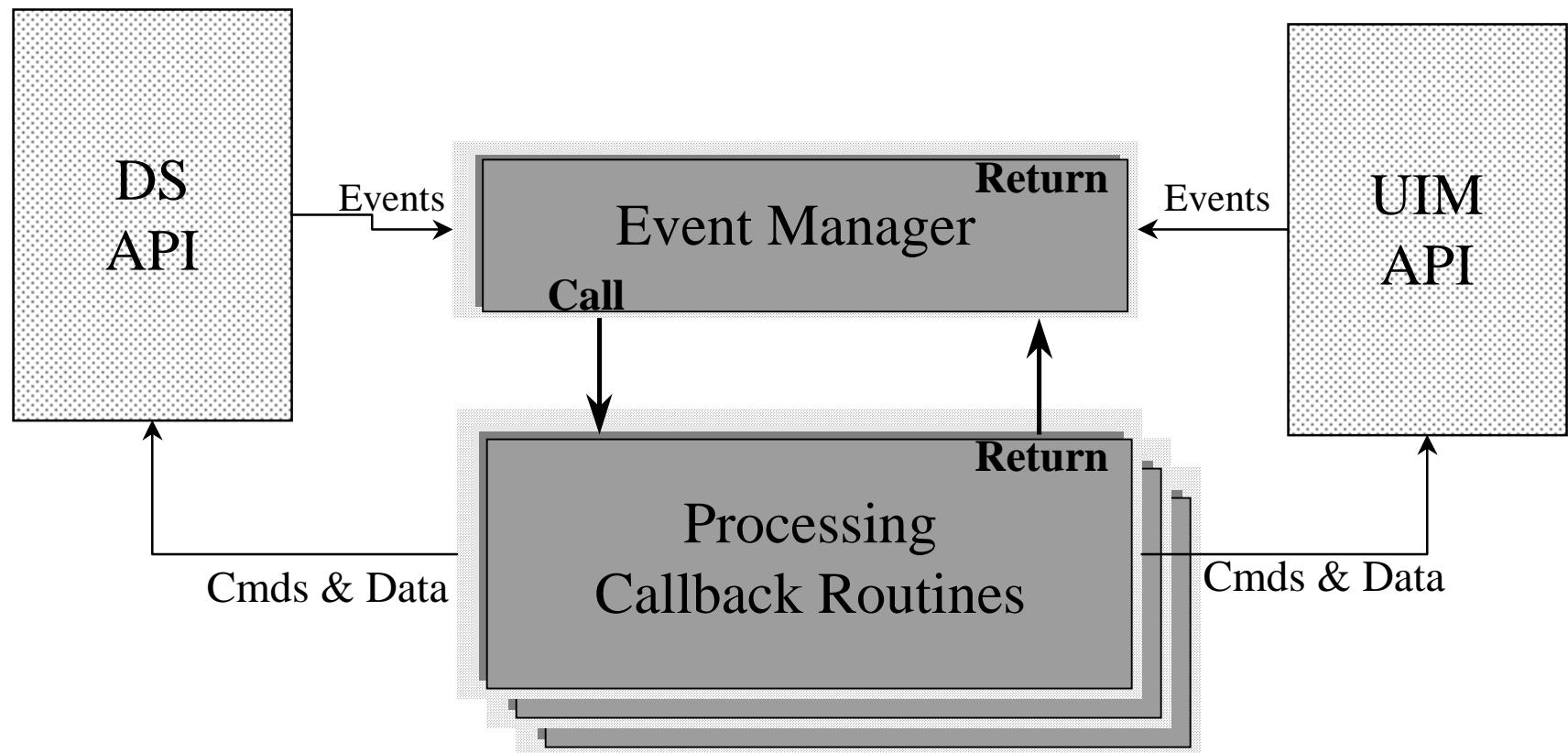


CSCs Startup - Recovery

- For most CSCs
 - No special processing is required
- *AV Control*
 - Place CSC in a “safe”, idle state
 - Inform operator of last operation
 - Wait for commands
- *DataLink Control*
 - Determine state of antenna/Satcom
 - If no downlink data
 - Initiate Search to recovery UAV



CSC Processing





CSC Shutdown

- Unregister callback routines
- Destroy DS and/or UIM objects
- Unload dependent CSCs



CAP Top Level Structure

- CAP consist of three main components and four run time selections
 - TCS - Main CAP program
 - Provides AV & Payload functionality
 - Setup
 - Provides functionality for maintaining TCS internal configuration

Preferences (Part of Setup)

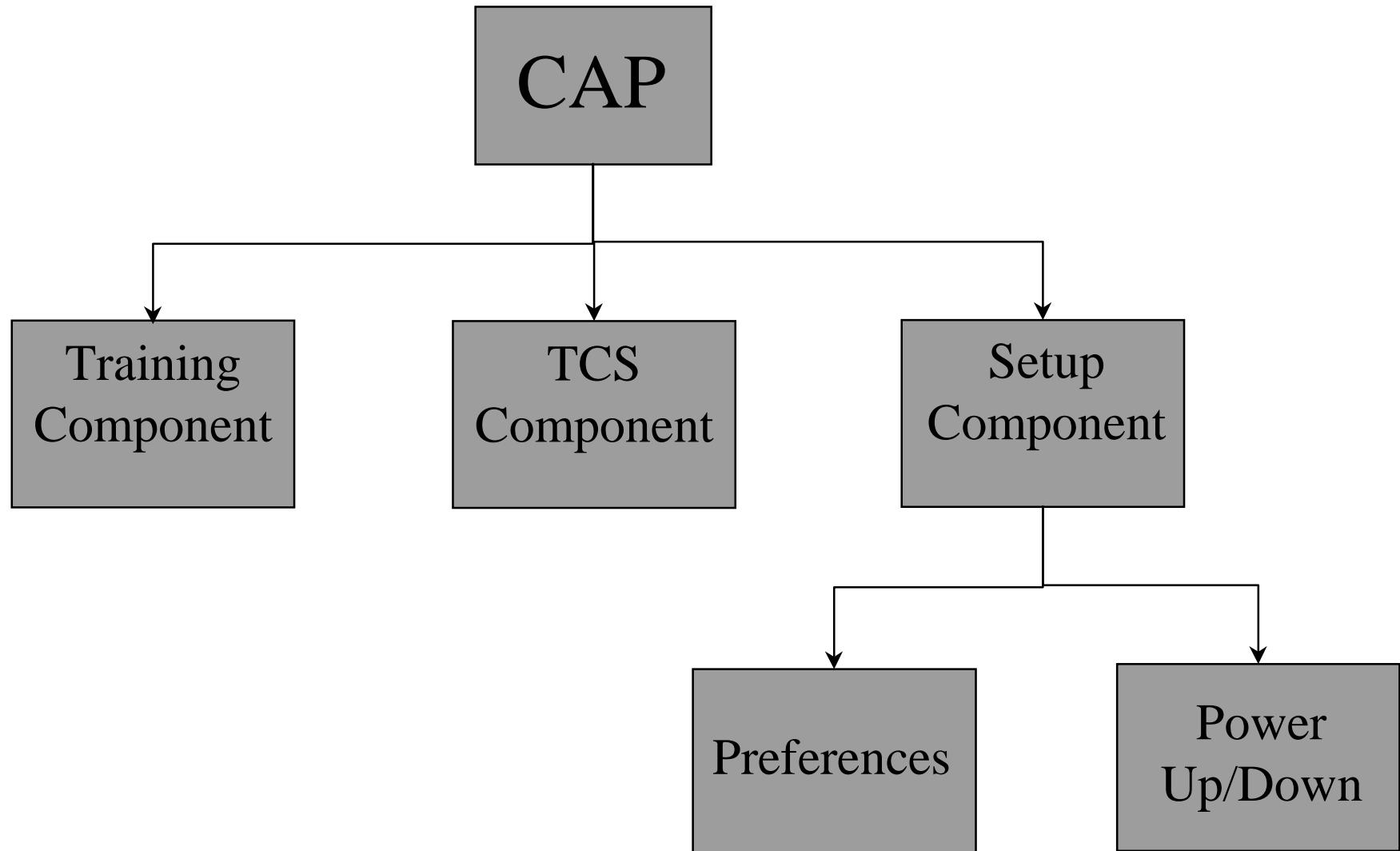
- Allows operator to specify preferences such as geo-coordinate type, some color and fonts, etc.

Power Up/Down (Part of Setup)

- Allows operator to shutdown equipment
- Training
 - Standalone training package that can be used as a standalone training aid or as a part of TCS component of online help,

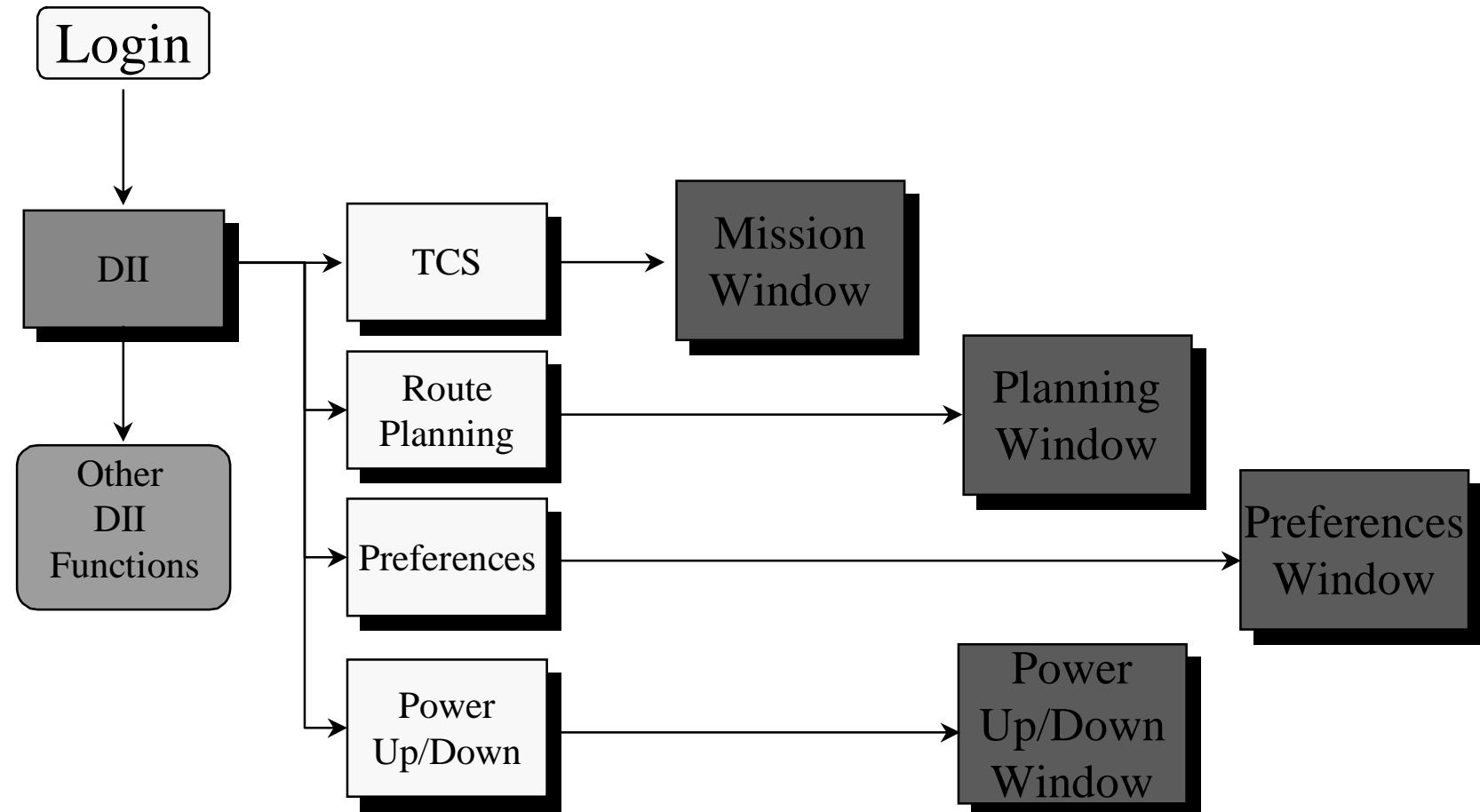


CAP Block Diagram



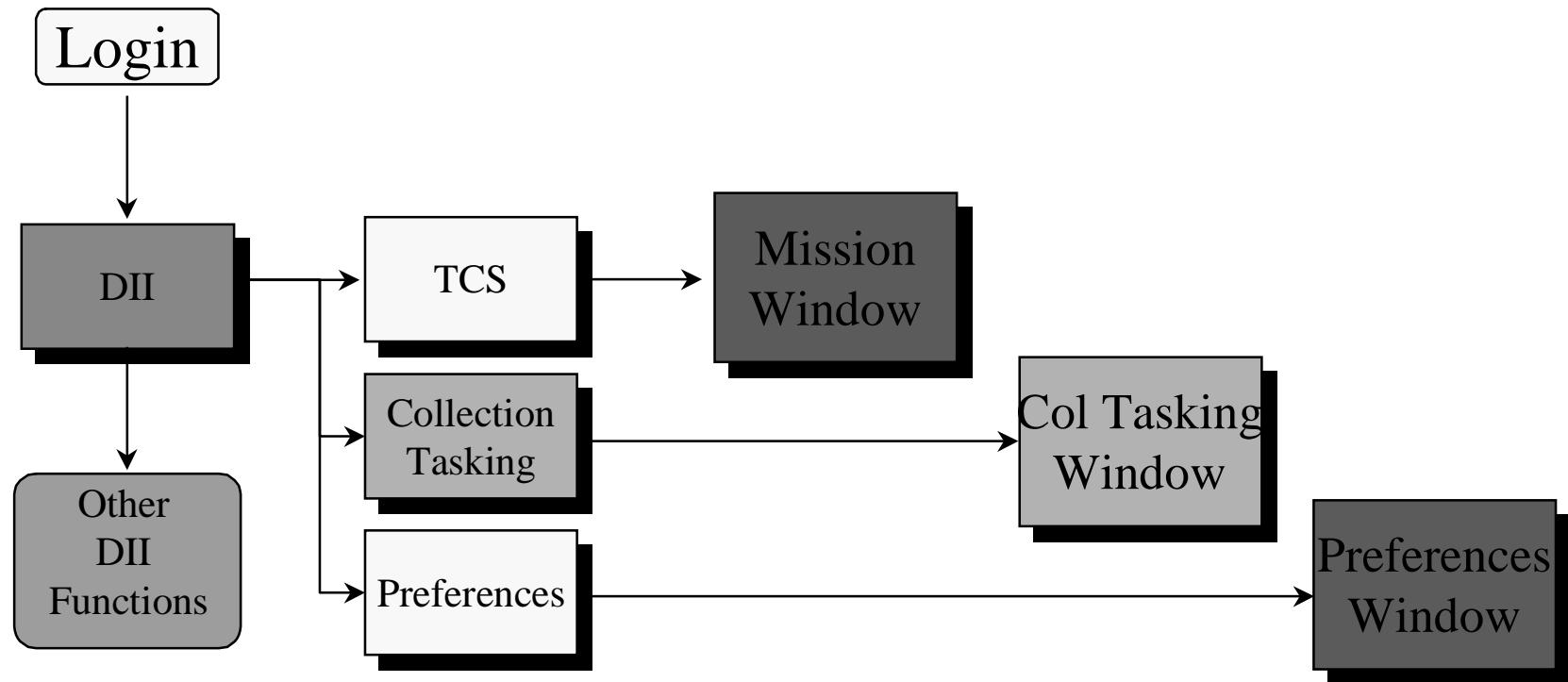


TCS Operator - Run Time Selections



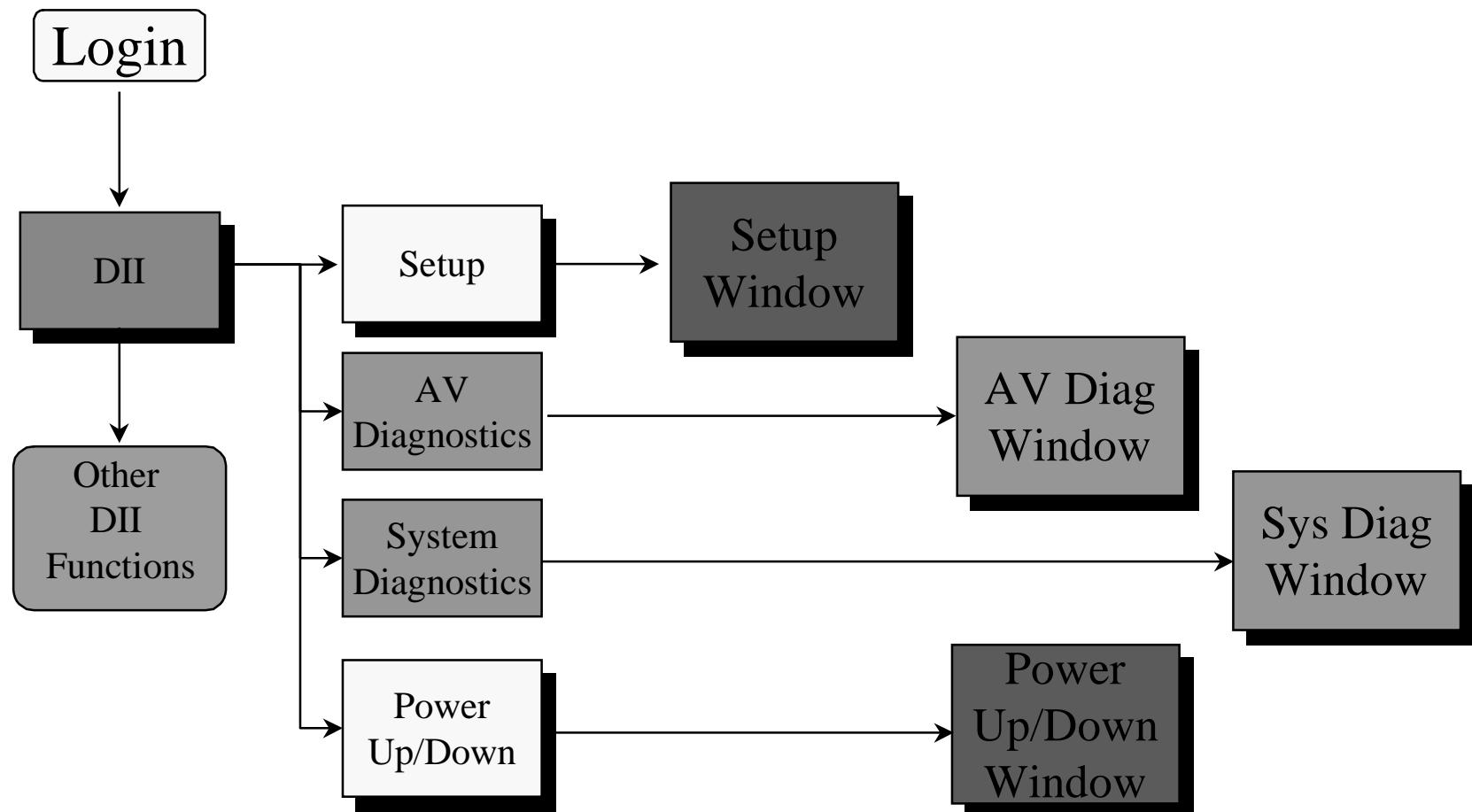


TCS User - Run Time Selections





TCS Admin - Run Time Selections



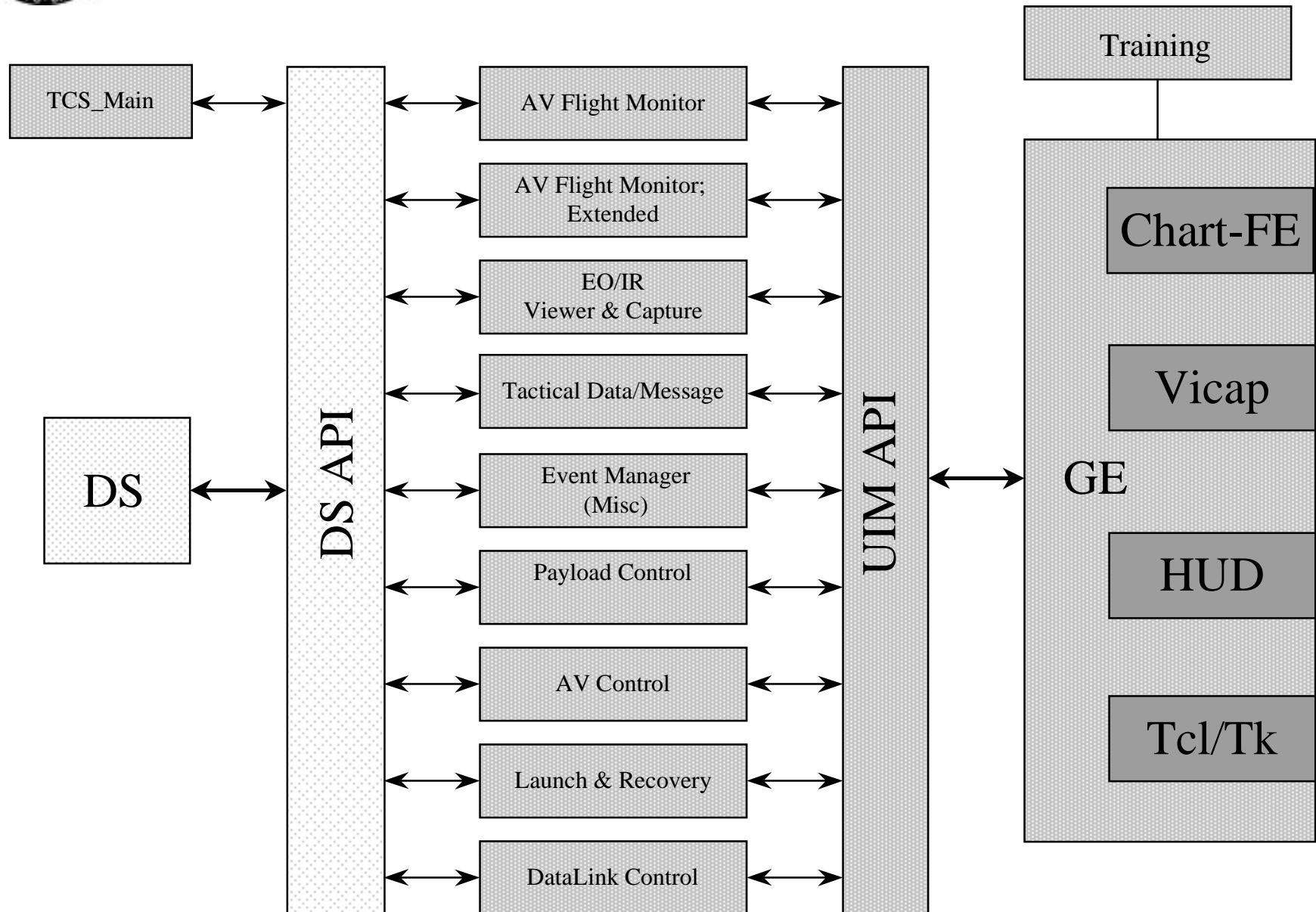


Changes from PDR Part I

- EO/IR Payload Control
 - Wrongly labeled
 - Should be called Payload Control
 - Payload Control is the main CSC for selecting and activating *payload(s)* support by a UAV
- Imagery Processing & Data Extraction Tool
 - Dropped as a CAP CSC
 - Reassigned as a DII component
 - Planned development to a TCS version of ICT (UNIX only)
 - Working on agreement with DISA, Mark Kuzma, to add our requirement for track/target designation to new JAVA version
 - Supports UNIX and NT platforms



CAP CSC Block Diagram





CAP Top Level Structure



Setup Component



Setup CSC (Alternate)

Name: Setup

Description:

Allows management of configuration parameters for a variety of login account classes.

TCS User:

Set user account Preferences

TCS Operator:

TCS User + power-down TCS equipment

TCS Admin:

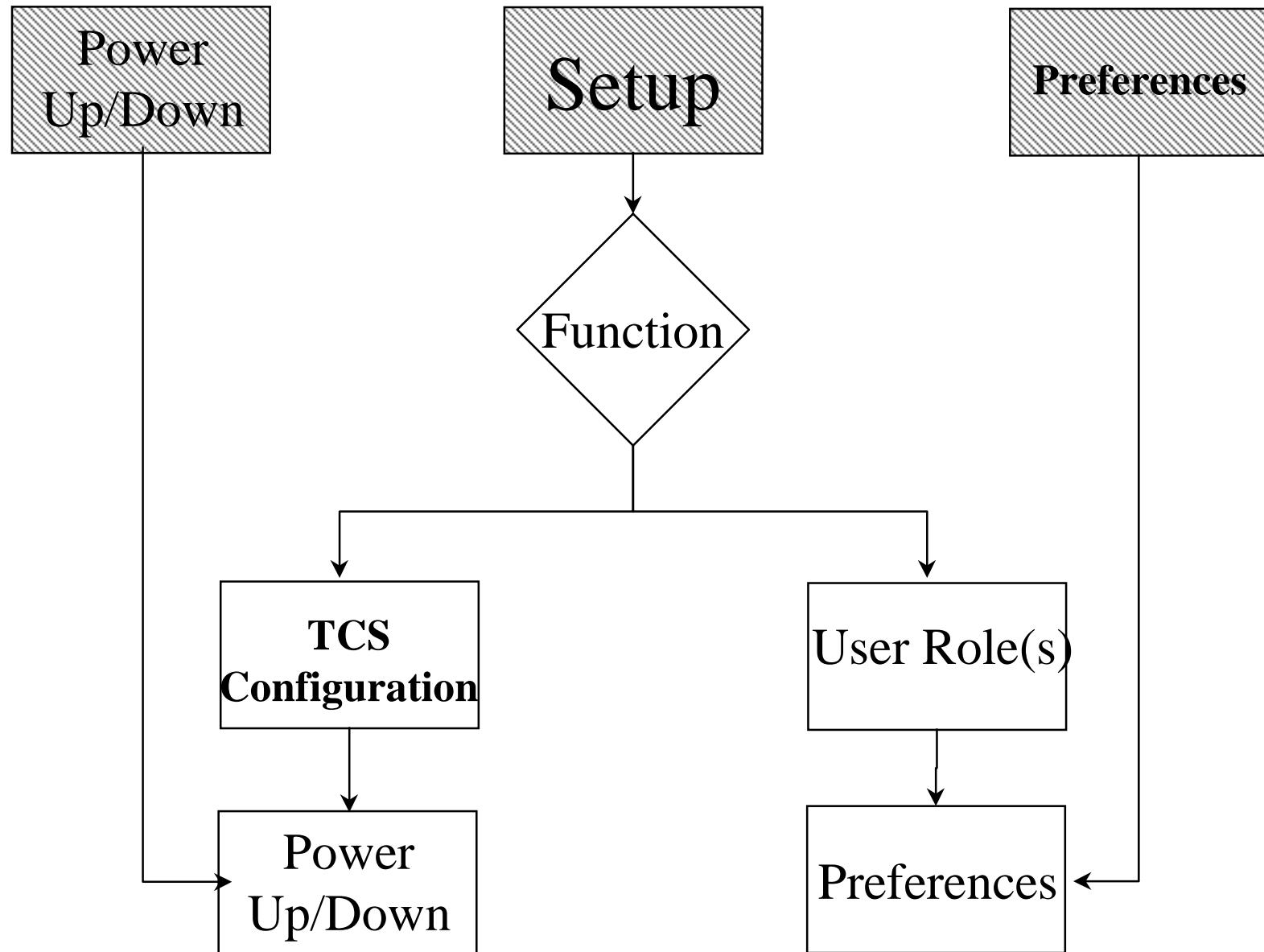
TCS operator + specify and/or change TCS's configuration database", verify and check the configuration to ensure that equipment is operational

Interfaces:

DS



Setup CSC Block Diagram

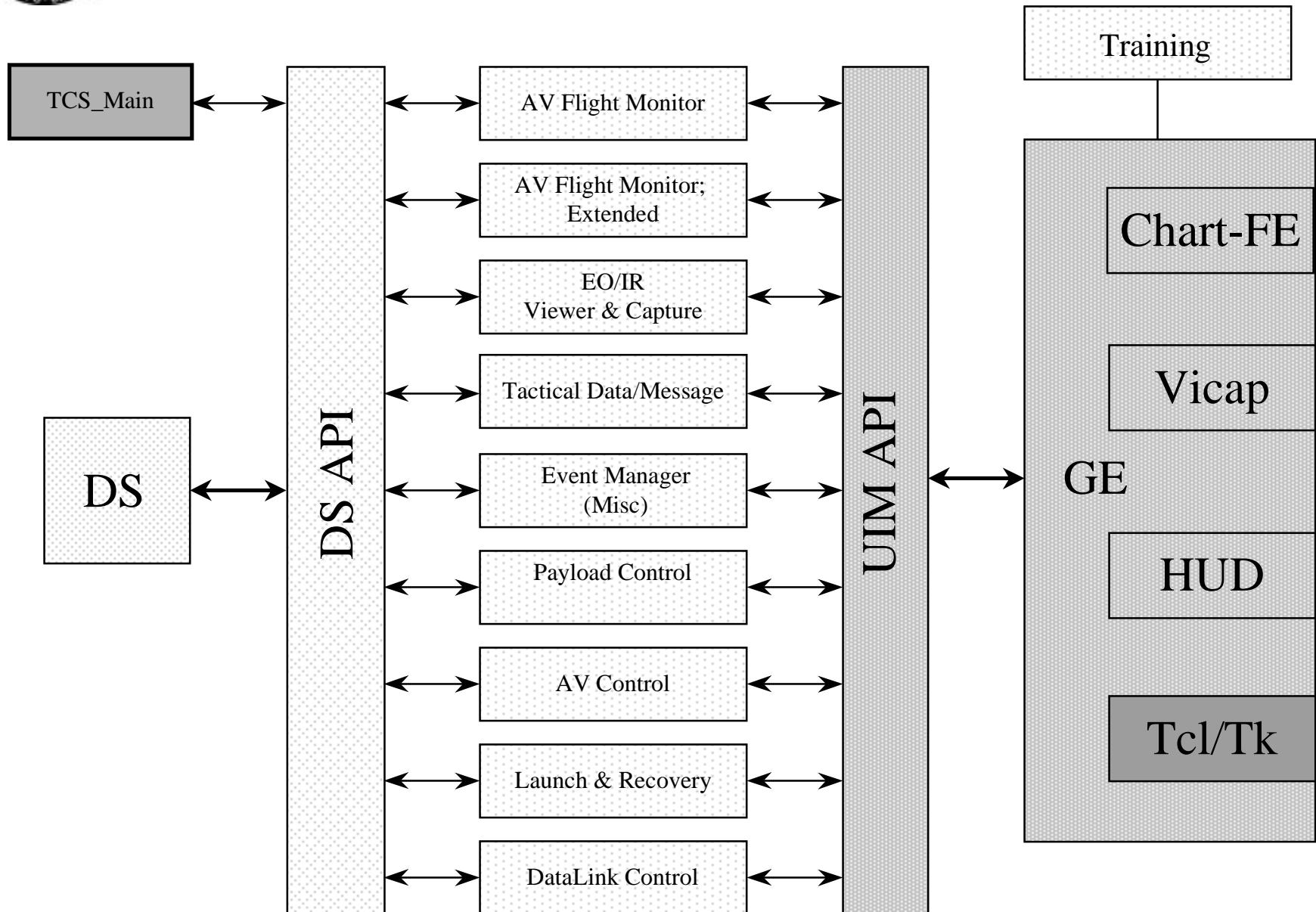




TCS Component



CAP CSC: TCS Main





TCS Main CSC

Name: TCS_Main

Description:

Establishes connections with DS and GE

Loads the appropriate CSCs based on role of user

Creates/Sends RTP configuration via DS

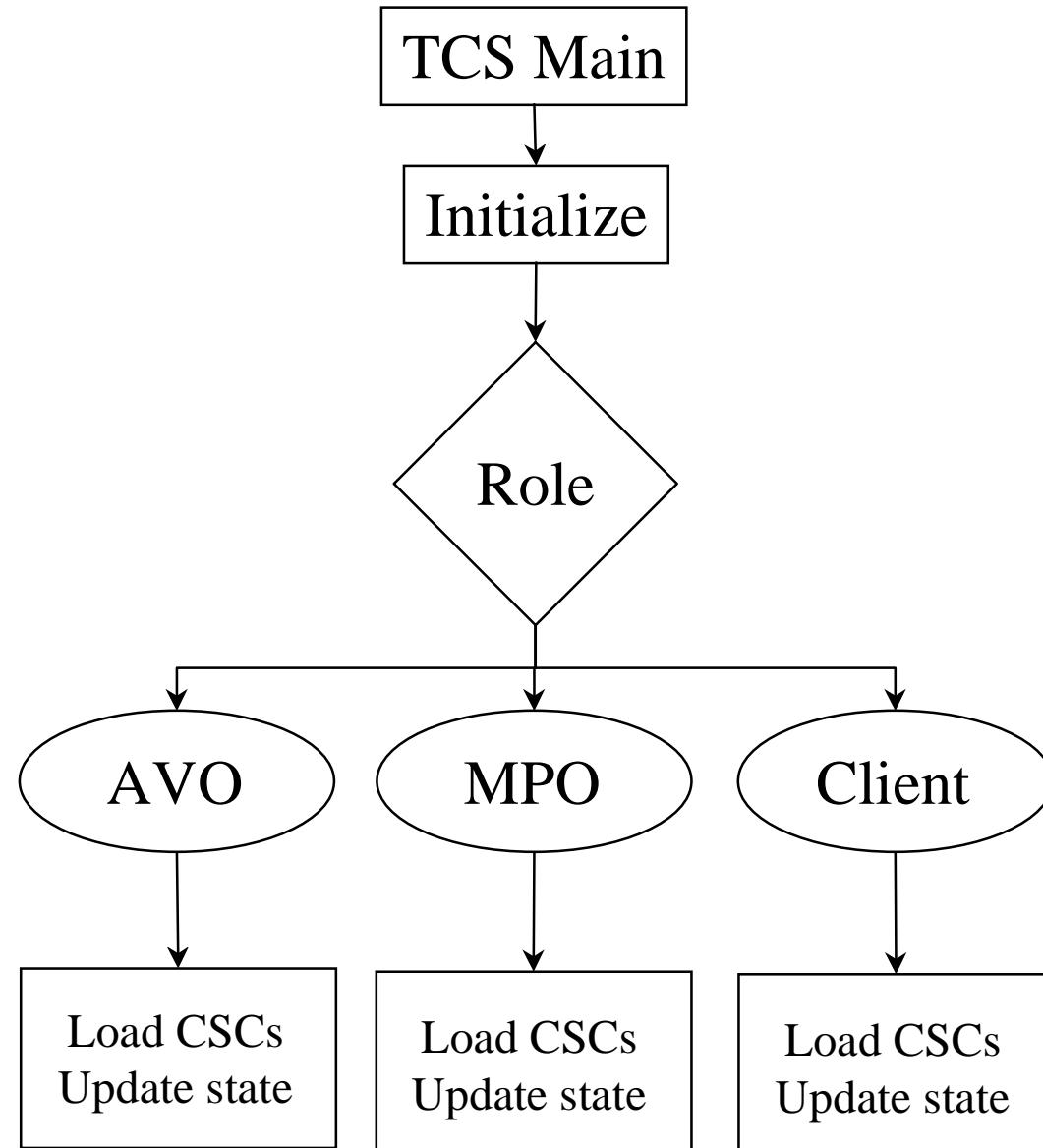
Creates/Sends state data to the DS

Interfaces:

DS, GE



TCS Main CSC Block Diagram





TCS Main - Inputs/Outputs

Inputs:

| |
|----------------|
| TCS_Config.ini |
|----------------|

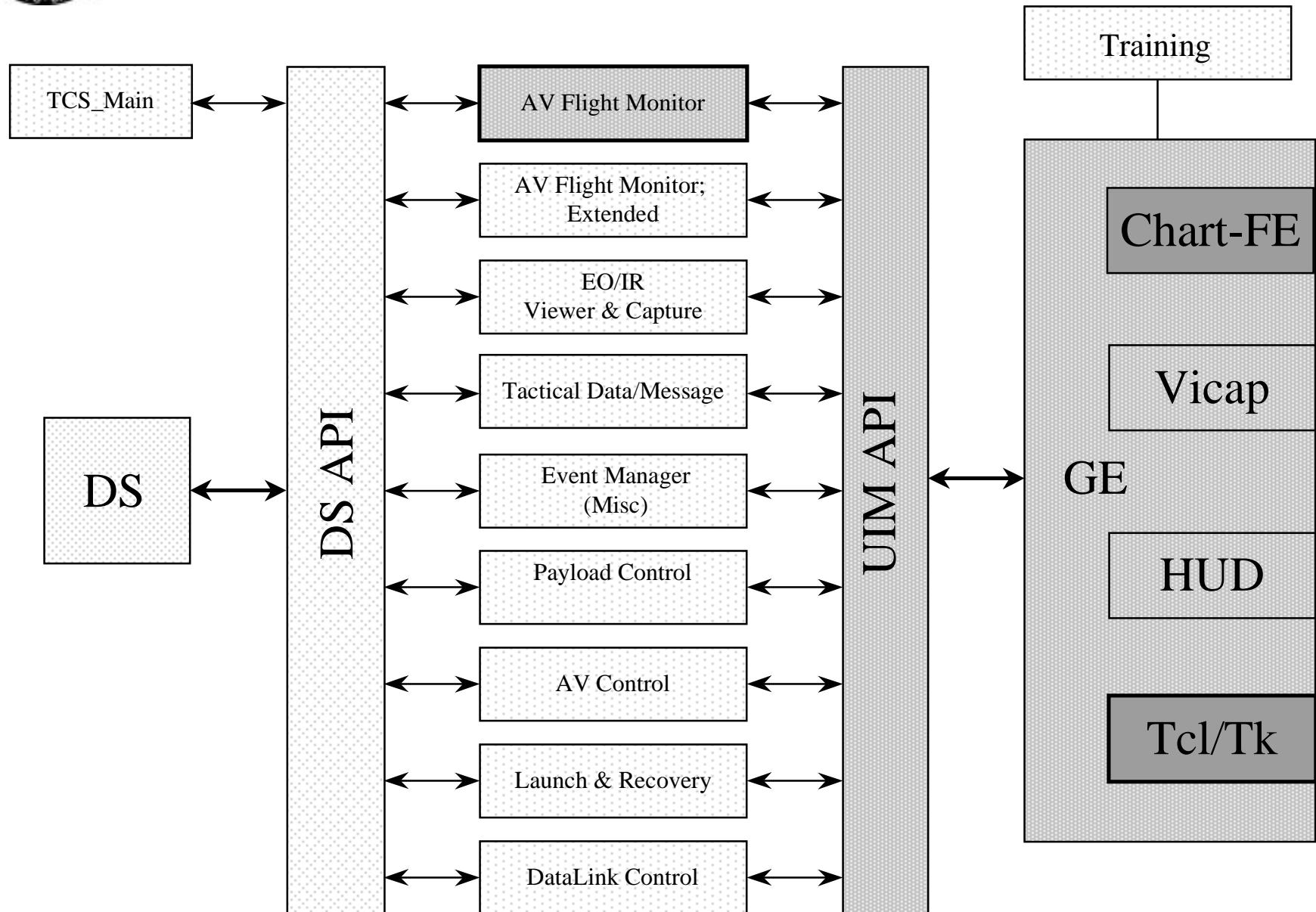
Output to DS:

| | |
|---------------|--------------------|
| DS_RTP_Config | (from “.ini” file) |
|---------------|--------------------|

| |
|---------------|
| DS_State_Data |
|---------------|



CAP CSC: AV Flight Monitoring





AV Flight Monitoring CSC

Name: AV Flight Monitoring

Description:

Receives AV status from DS.

Displays the AV status.

Displays the AV ICON.

Receives the TCS position from DS.

Displays the TCS ICON.

Sets the AV preferences.

Displays payload swath.

Receives flight route data from DS.

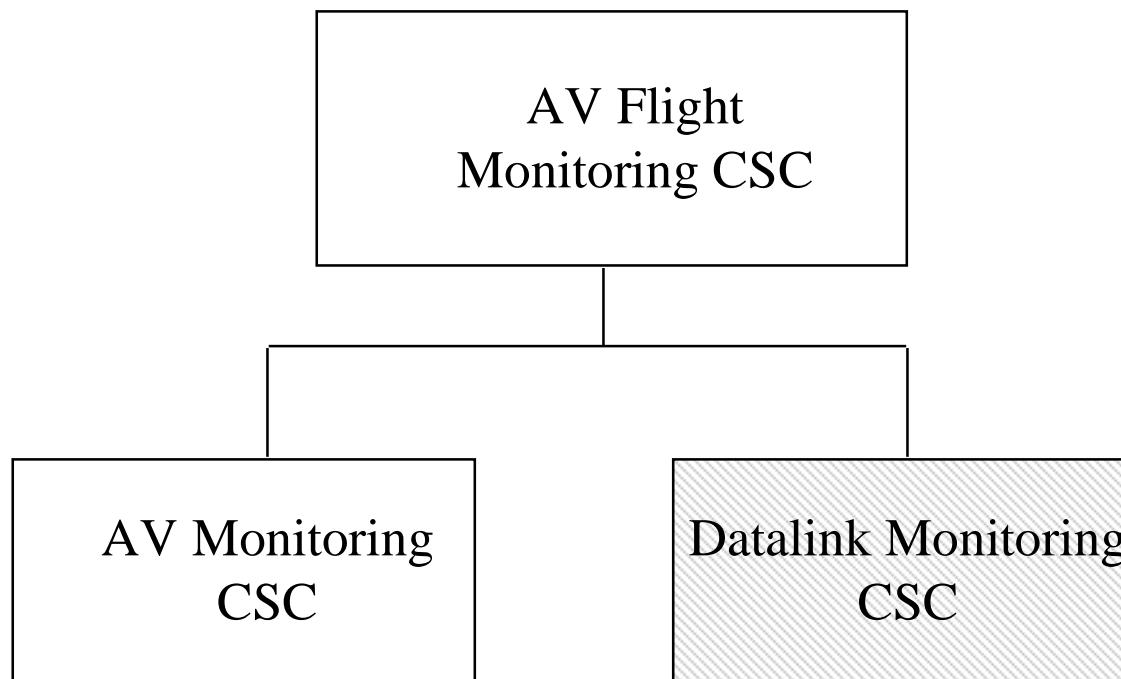
Sends flight route data to GE.

Interfaces:

DS, GE

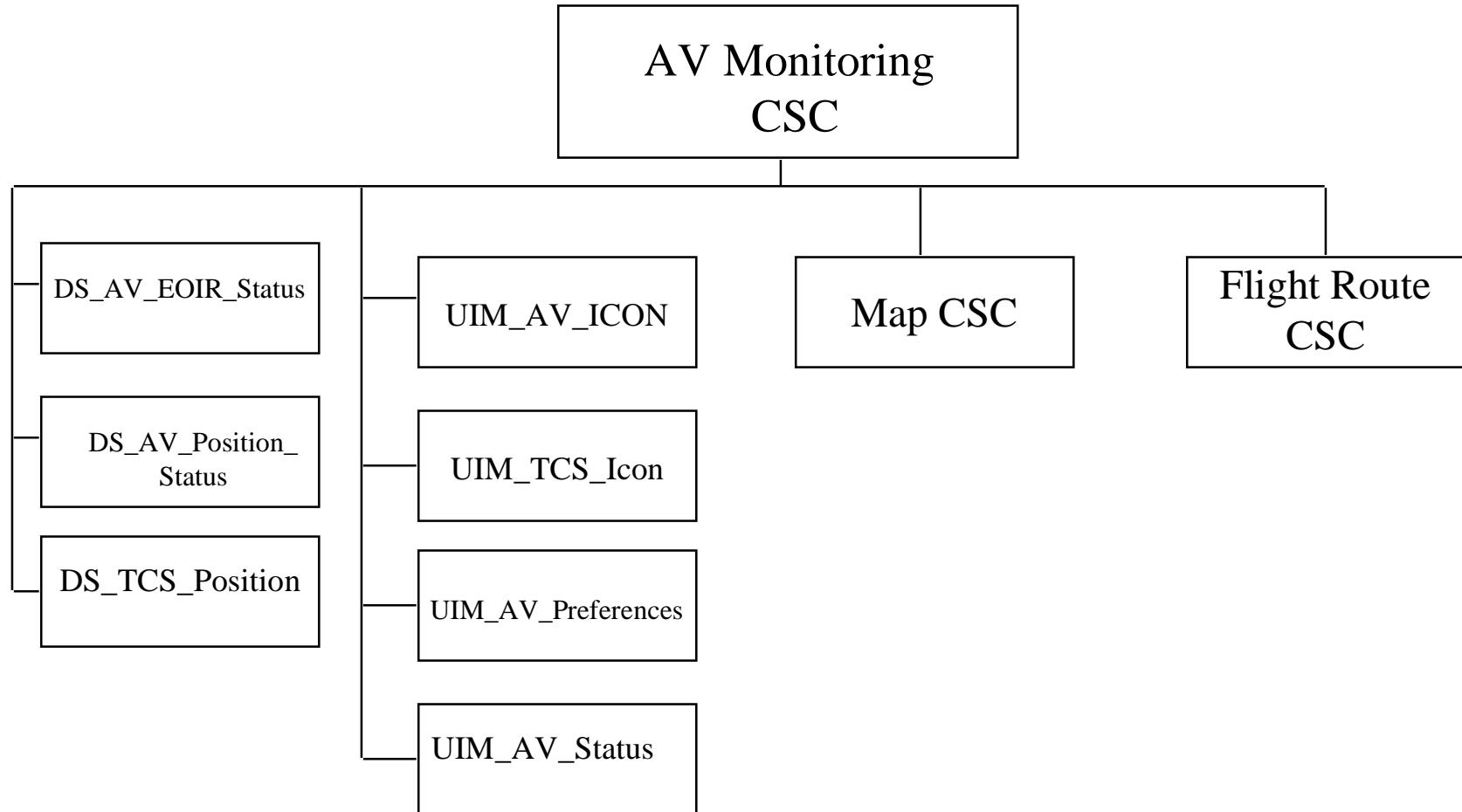


AV Flight Monitoring CSC Block Diagram





AV Monitoring Block Diagram





AV Monitoring - Inputs/Outputs

From DS to GE:

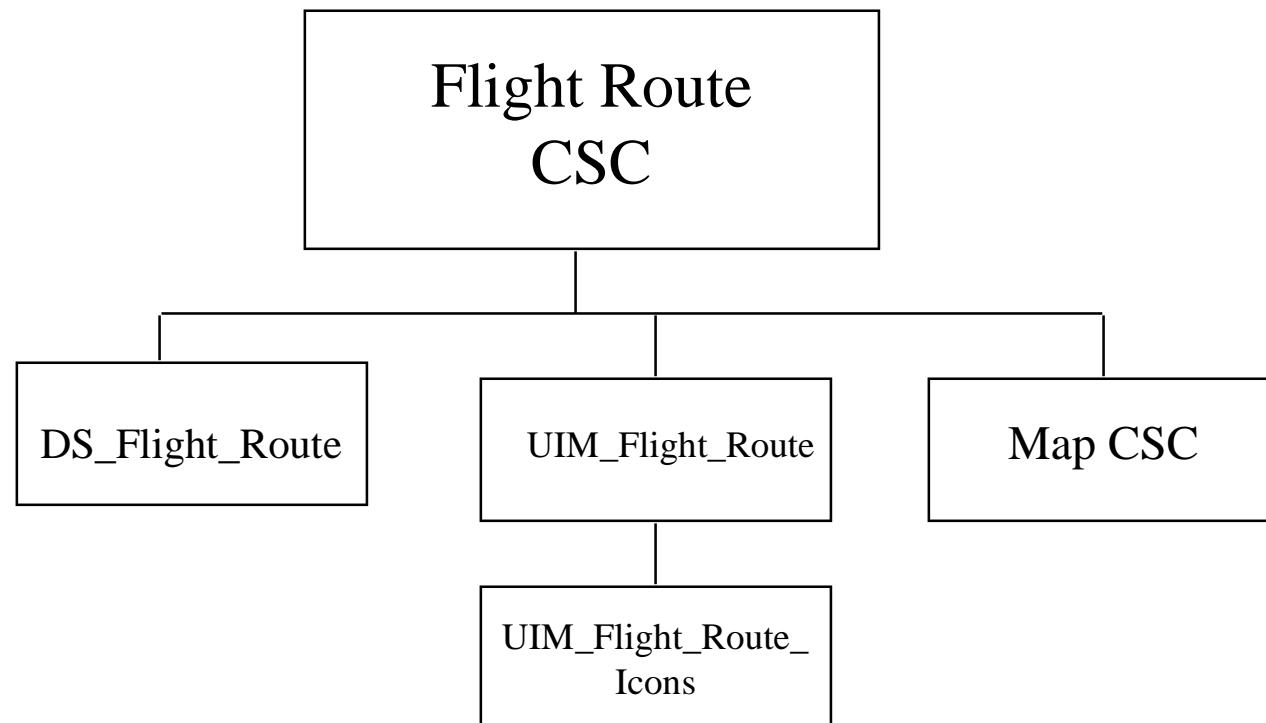
| | |
|-----------------------|---------------|
| DS_AV_EOIR_Status | UIM_AV_Status |
| DS_AV_Position_Status | UIM_AV_Status |
| DS_TCS_Position | UIM_TCS_Icon |

To GE:

UIM_AV_Preferences



Flight Route Block Diagram





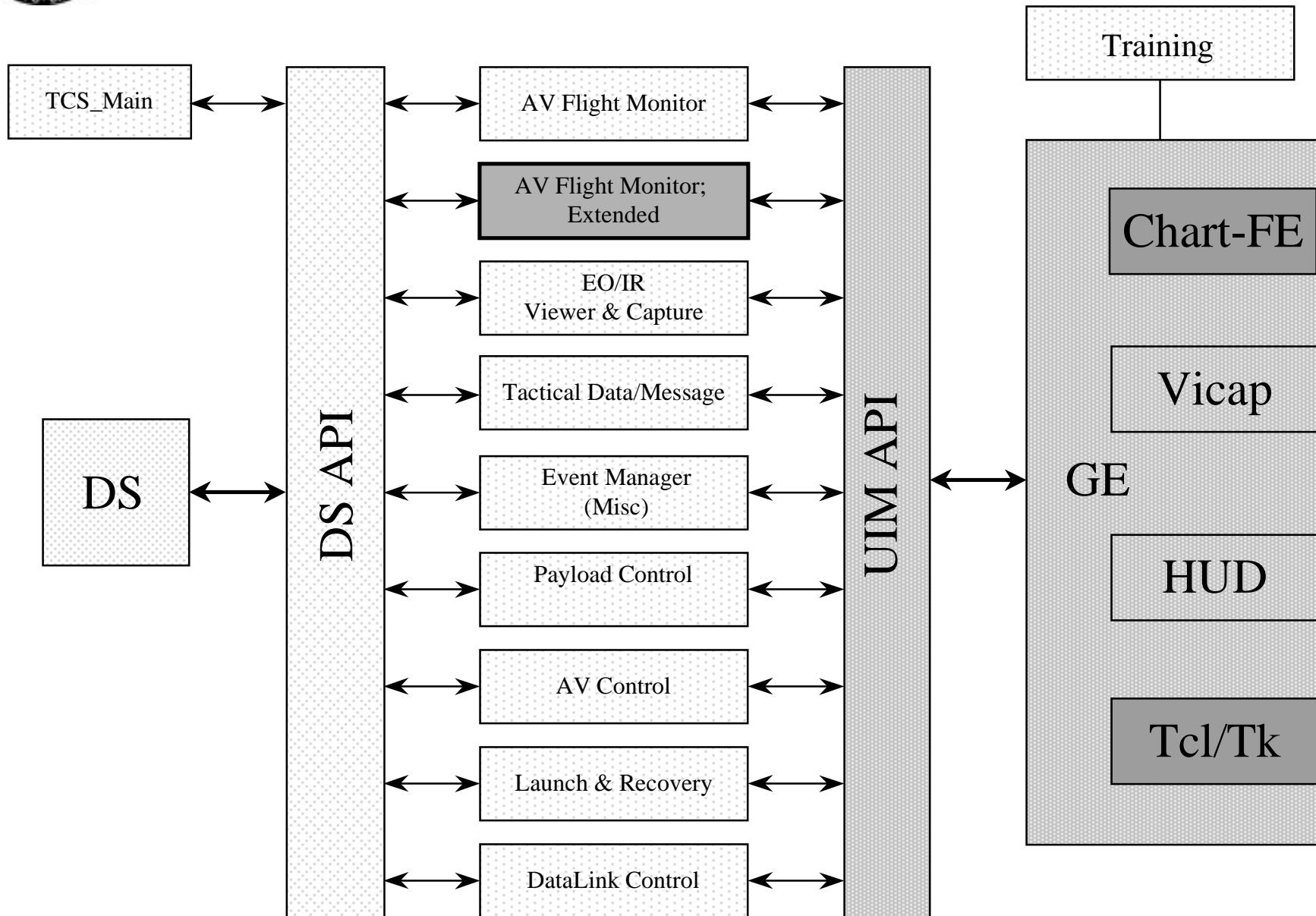
Flight Route - Inputs/Outputs

From DS to GE:

| | |
|-----------------|--------------------------|
| DS_Flight_Route | UIM_Flight_Route |
| | UIM_Flight_Route_Symbols |



CAP CSC: AV Flight Monitoring; Extended





AV Flight Monitoring Extended CSC

Name: Flight Monitoring Extended

Description:

Displays AV, Datalink, and Payload Warnings

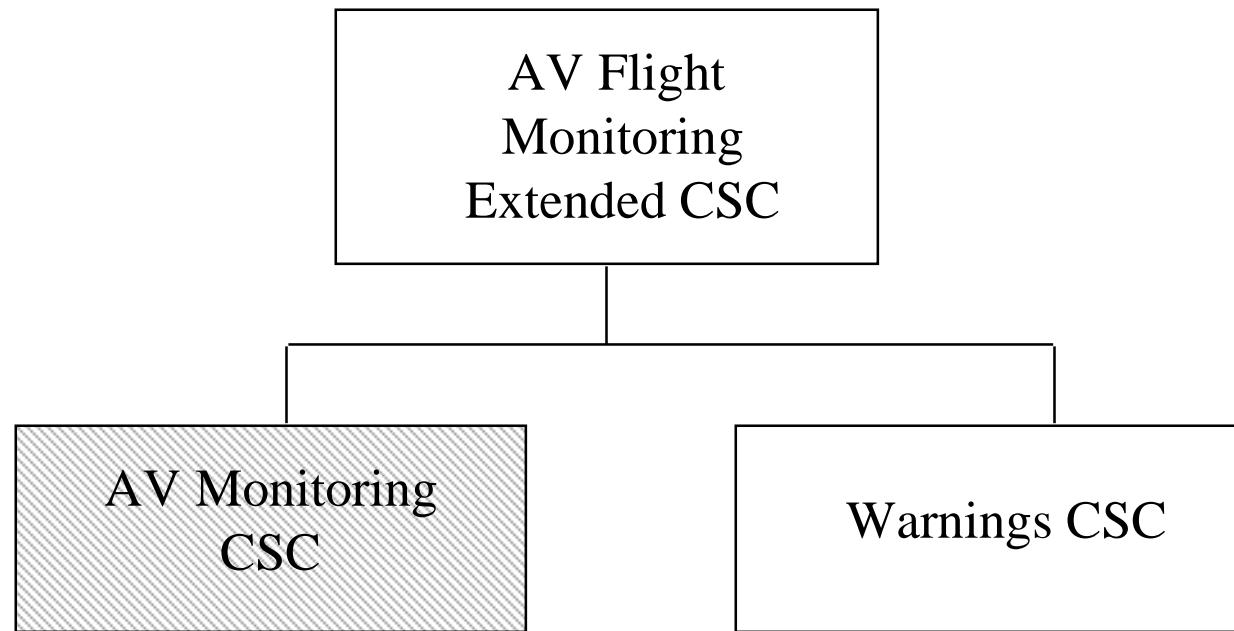
Interfaces:

DS, UIM



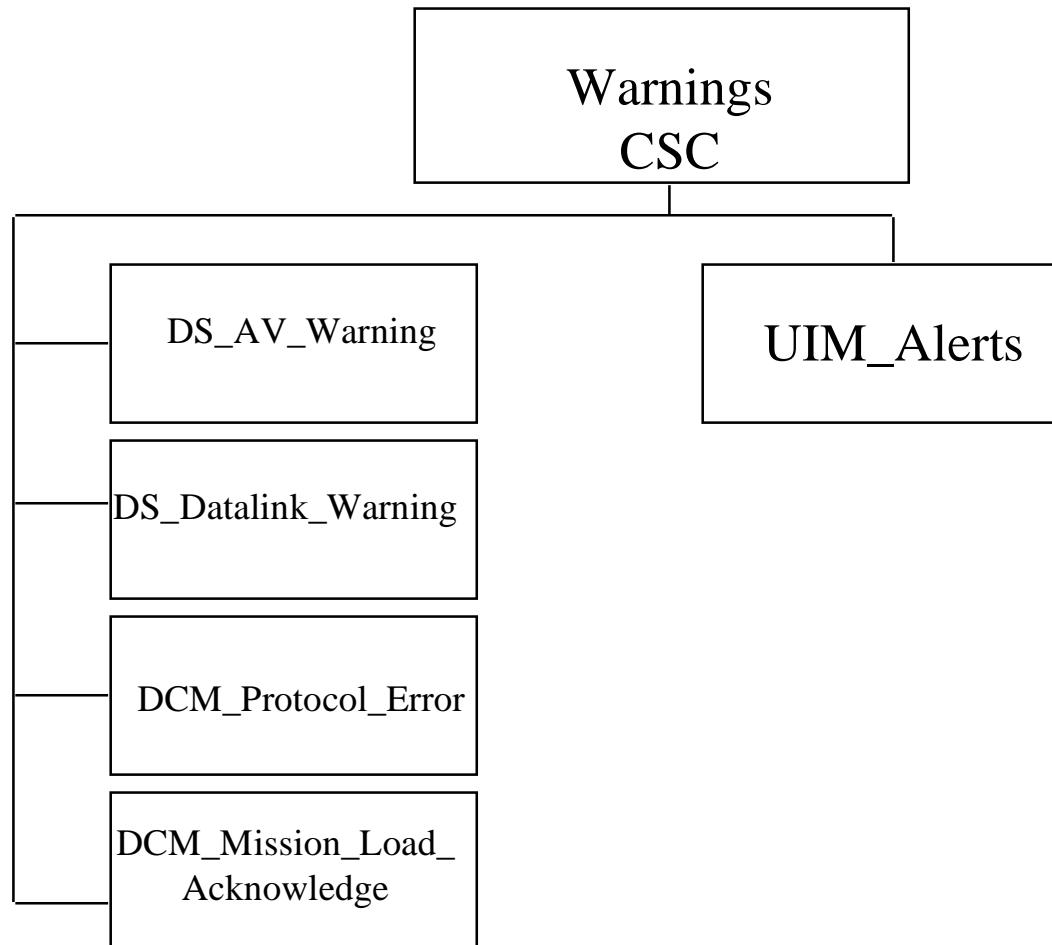
AV Flight Monitoring Extended CSC

Block Diagram





Warnings Block Diagram





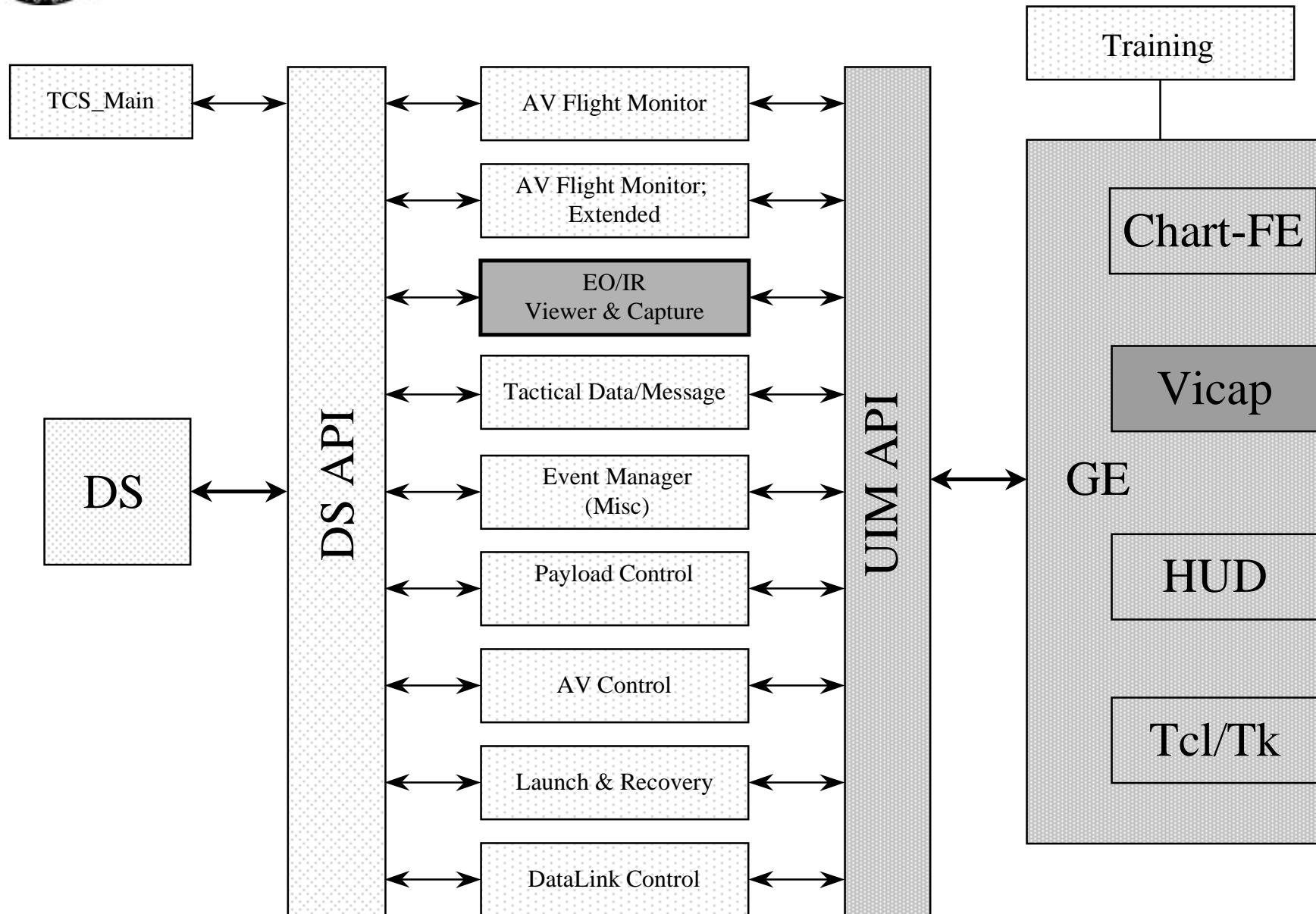
Warnings - Inputs/Outputs

From DS to GE:

| | |
|------------------------------|-----------|
| DS_AV_Warning | UIM_Alert |
| DS_Datalink_Warning | |
| DCM_Protocol_Error | |
| DCM_Mission_Load_Acknowledge | |



CAP CSC: EO/IR Viewer & Capture





EO/IR Imagery Viewer and Capture CSC

Name: EO/IR Imagery Viewer and Capture CSC

Description:

Provide timely display of EO/IR payload video and status data in support of payload monitoring and imagery collection

- Video display
- Status data
- NITF Image Capture

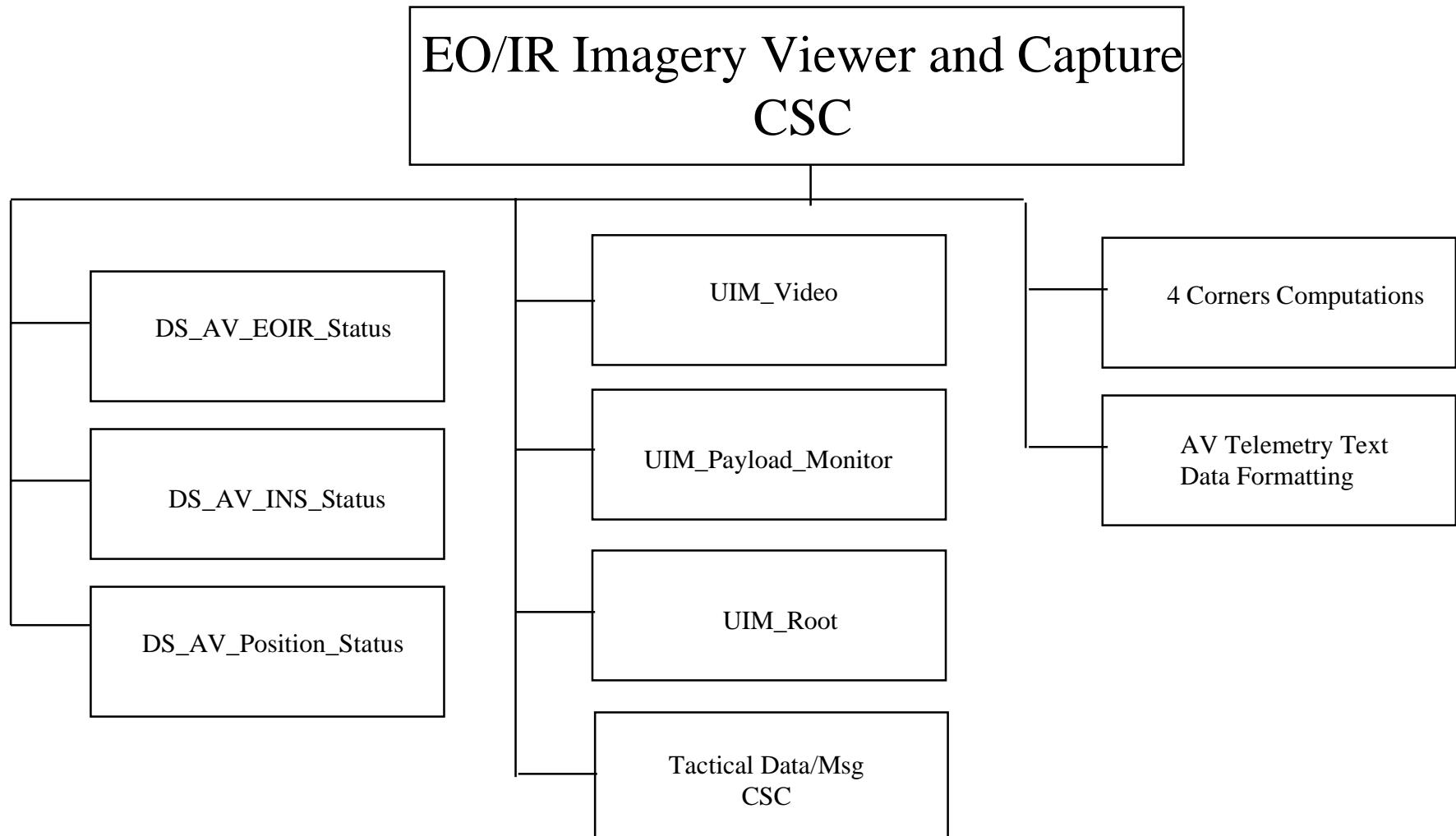
Interfaces:

DS, GE



EO/IR Imagery Viewer and Capture CSC

Block Diagram





EO/IR Imagery Viewer & Capture

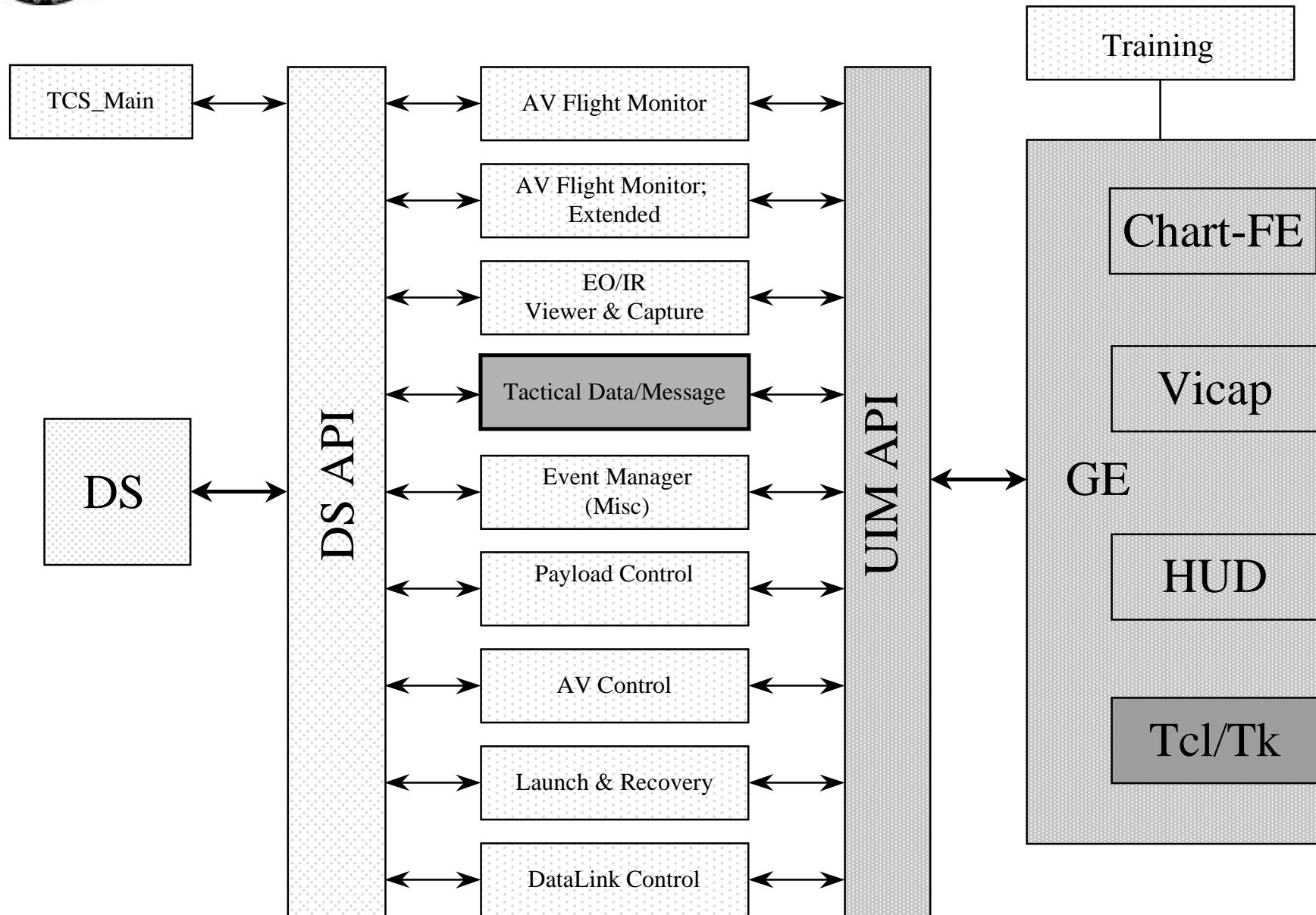
Inputs/Outputs

From DS to GE:

| | |
|------------------------------|----------------------------|
| DS_AV_EOIR_Status | UIM_Payload_Monitor |
| DS_AV_INS_Status | |
| DS_AV_Position_Status | |



CAP CSC: Tactical Data/Msg





Tactical Data/Msgs CSC

Name: Tactical Data/Messages

Description:

Generate track/target data for DII's tactical picture.

Generate tactical messages for output via DII's UCP. The content of each message generated is based upon the tracks/targets identified

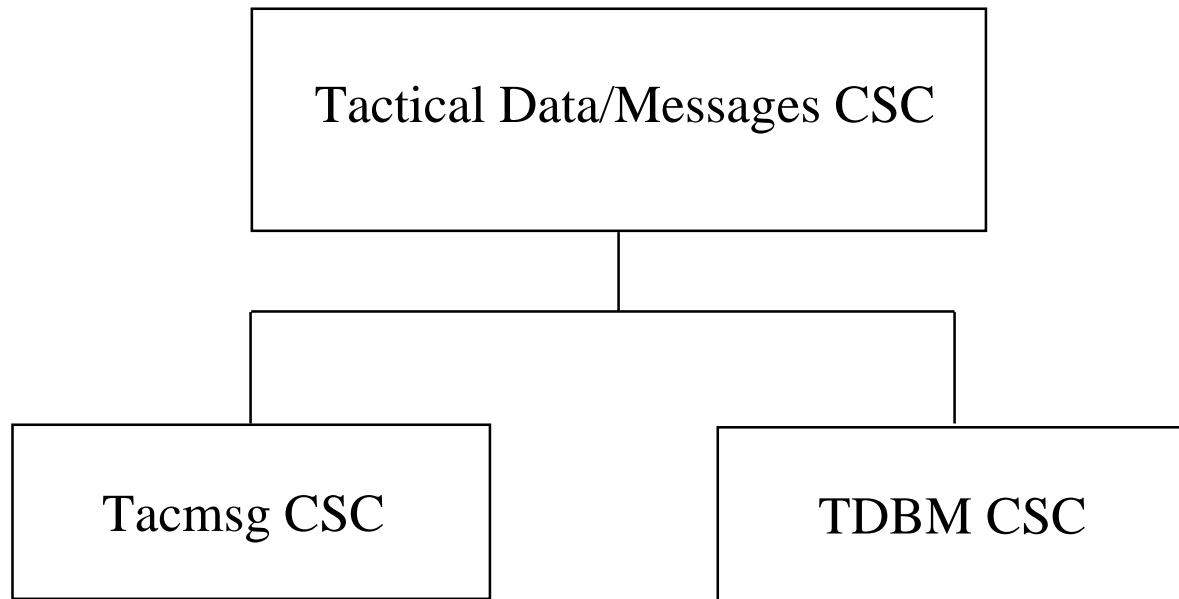
Interfaces:

GE, DII TDBM API, DII UCP API



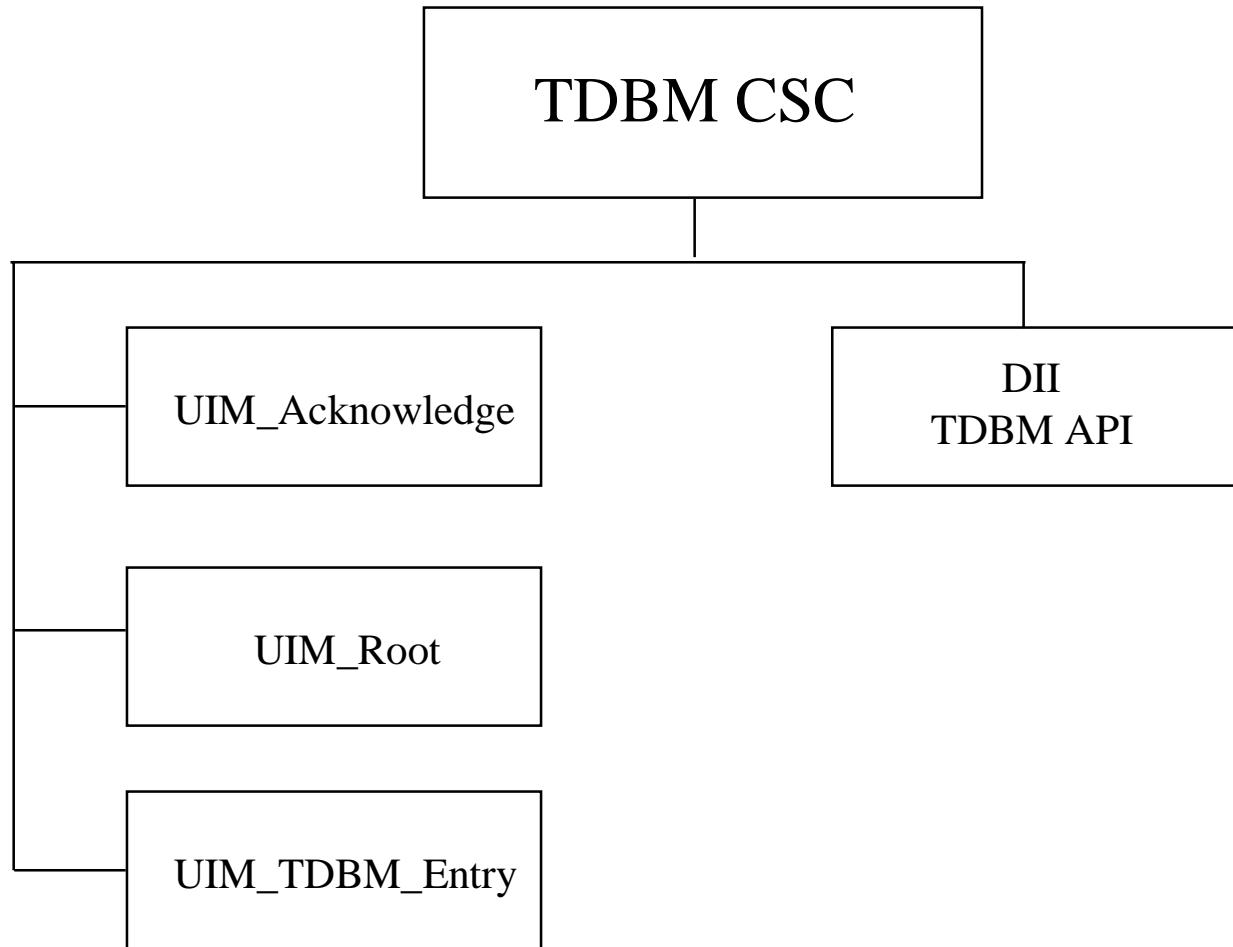
Tactical Data/Messages CSC

Block Diagram





TDBM Block Diagram





TDBM - Inputs/Outputs

From GE:

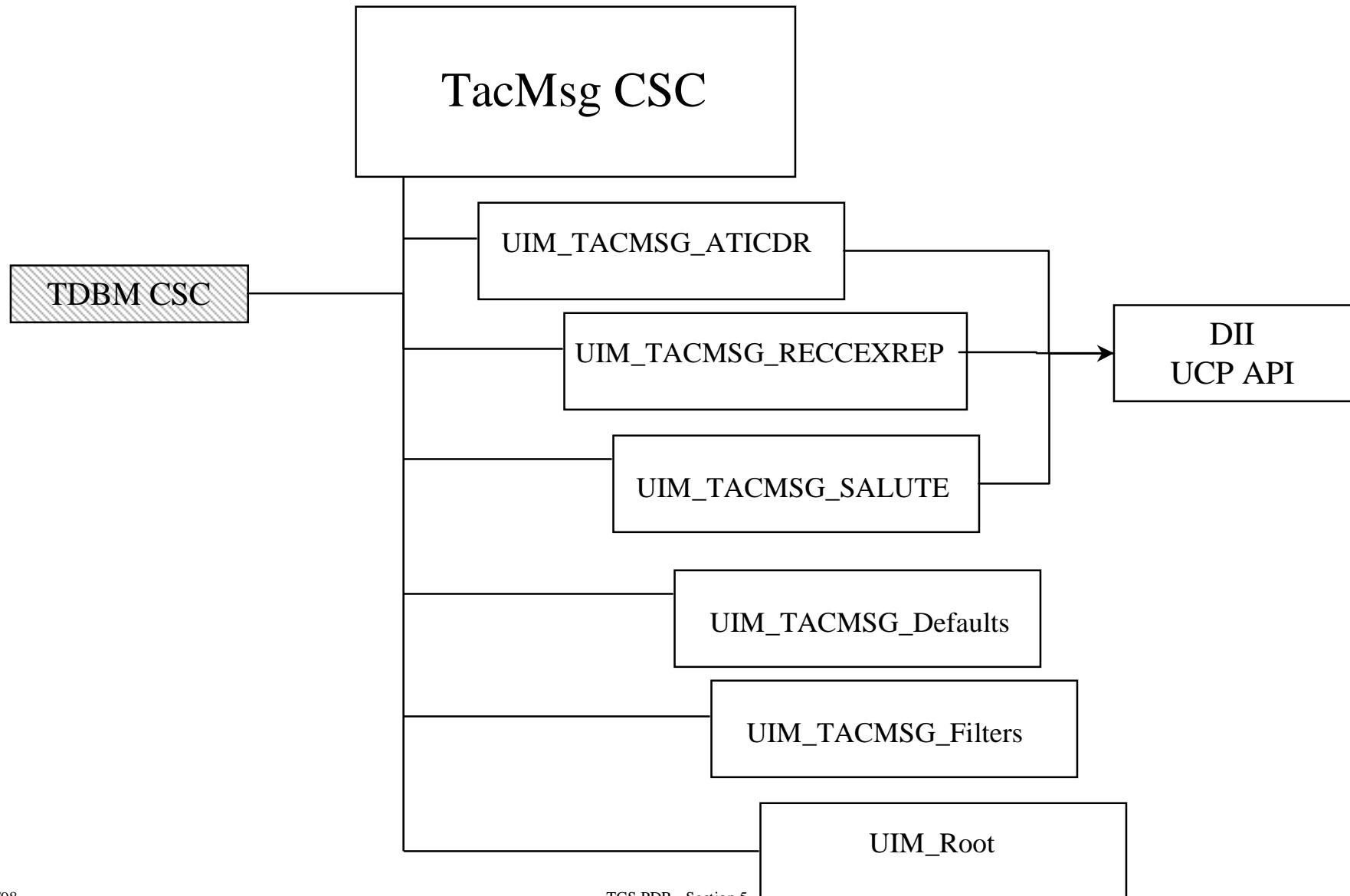
UIM_TDBM_Entry

To DII's Tactical DataBase:

Track Data



TacMsg Block Diagram





TacMsg - Inputs/outputs

From TDBM:

Track/Target Data

To GE:

UIM_TACMSG_ATICDR

UIM_TACMSG_ATICDR

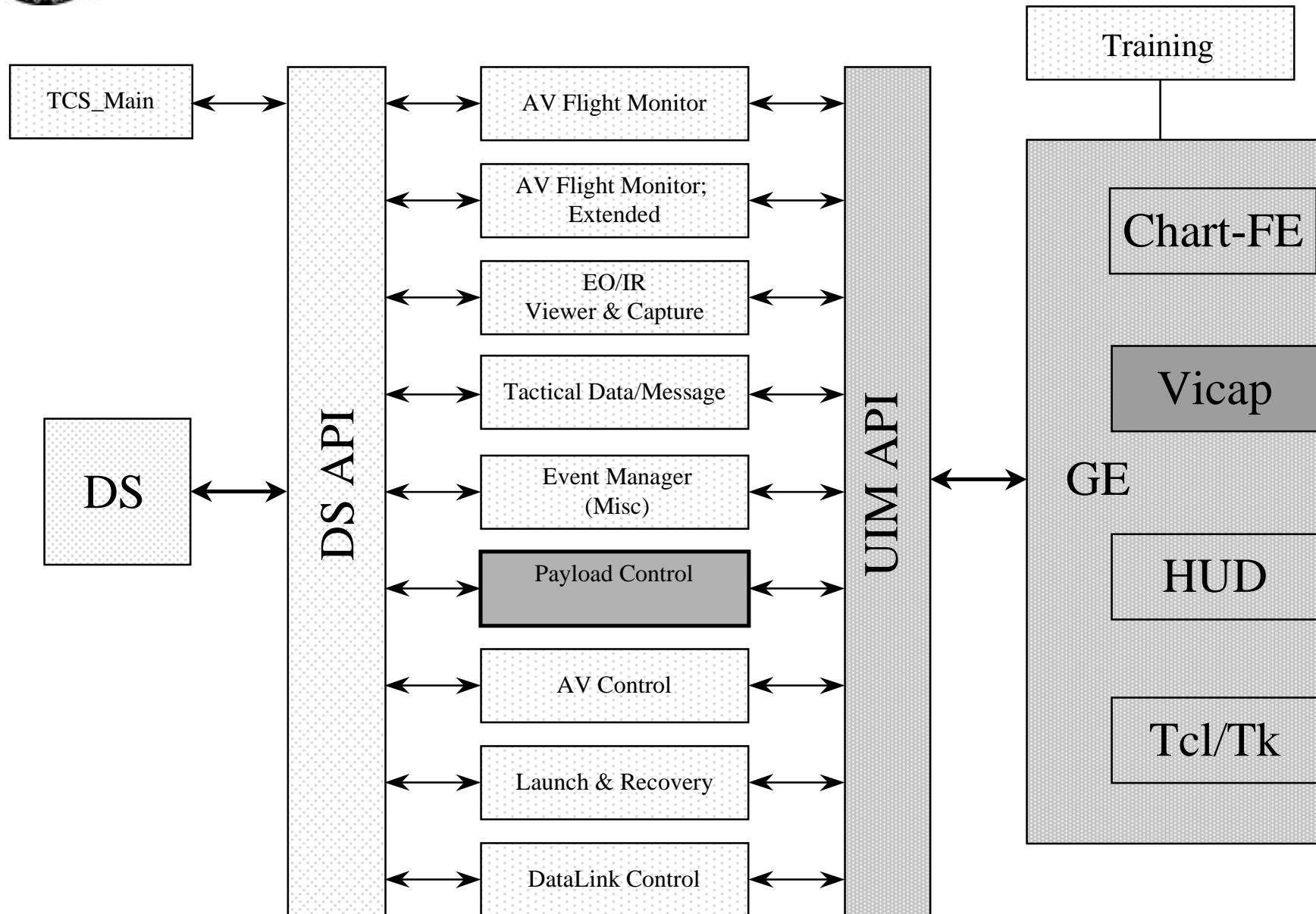
UIM_TACMSG_ATICDR

To DII's UCP:

Tactical Message Data



CAP CSC: Payload Control





Payload Control CSC

Name: Payload Control

Description:

Provide overall management and control for payloads support by an UAV. Primary function of this CSC is the selection of the payload to be controlled by the operator.

Note: At present EO/IR is the only type of payload supported via this function.

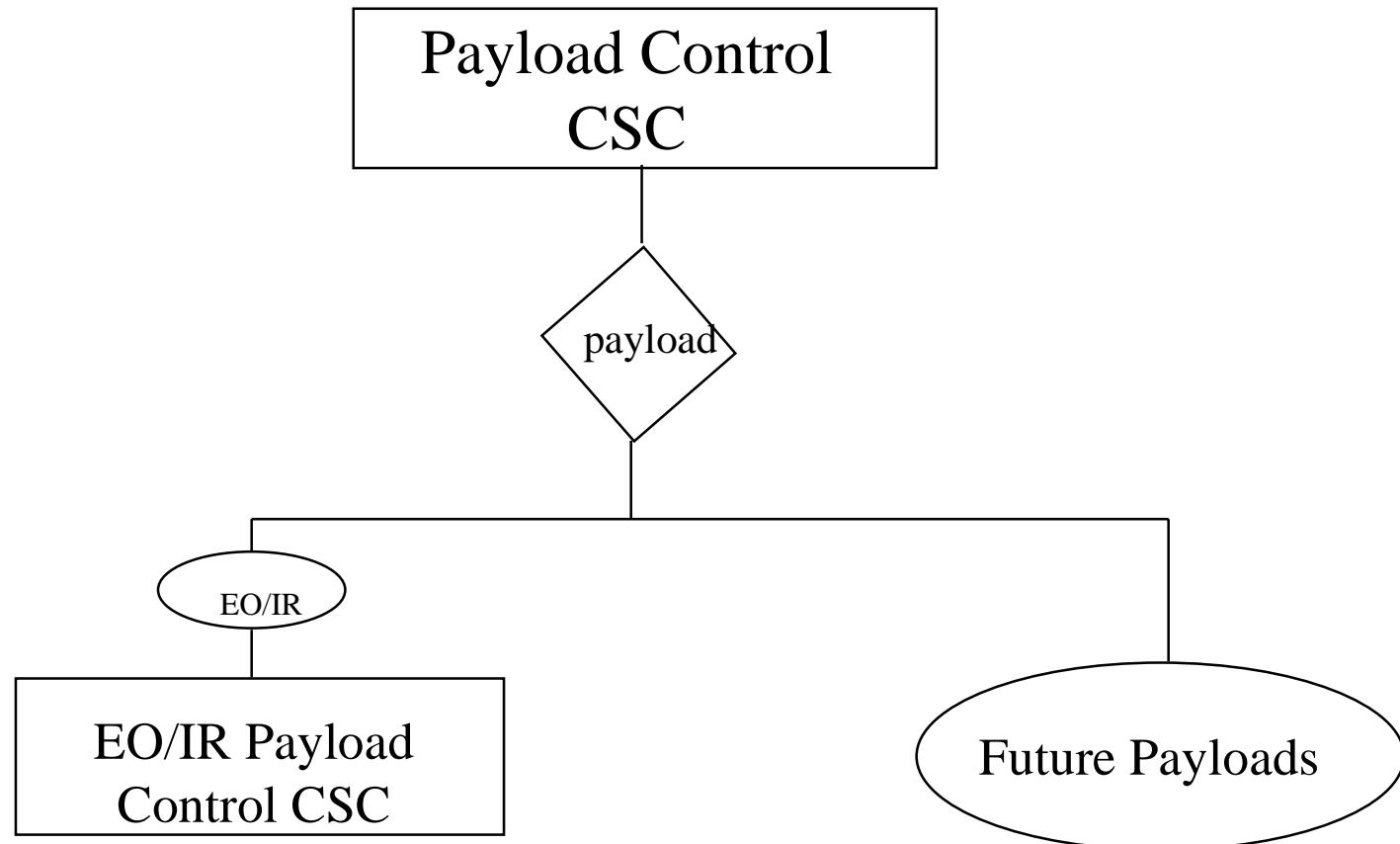
Interfaces:

DS, GE



Payload Control CSC

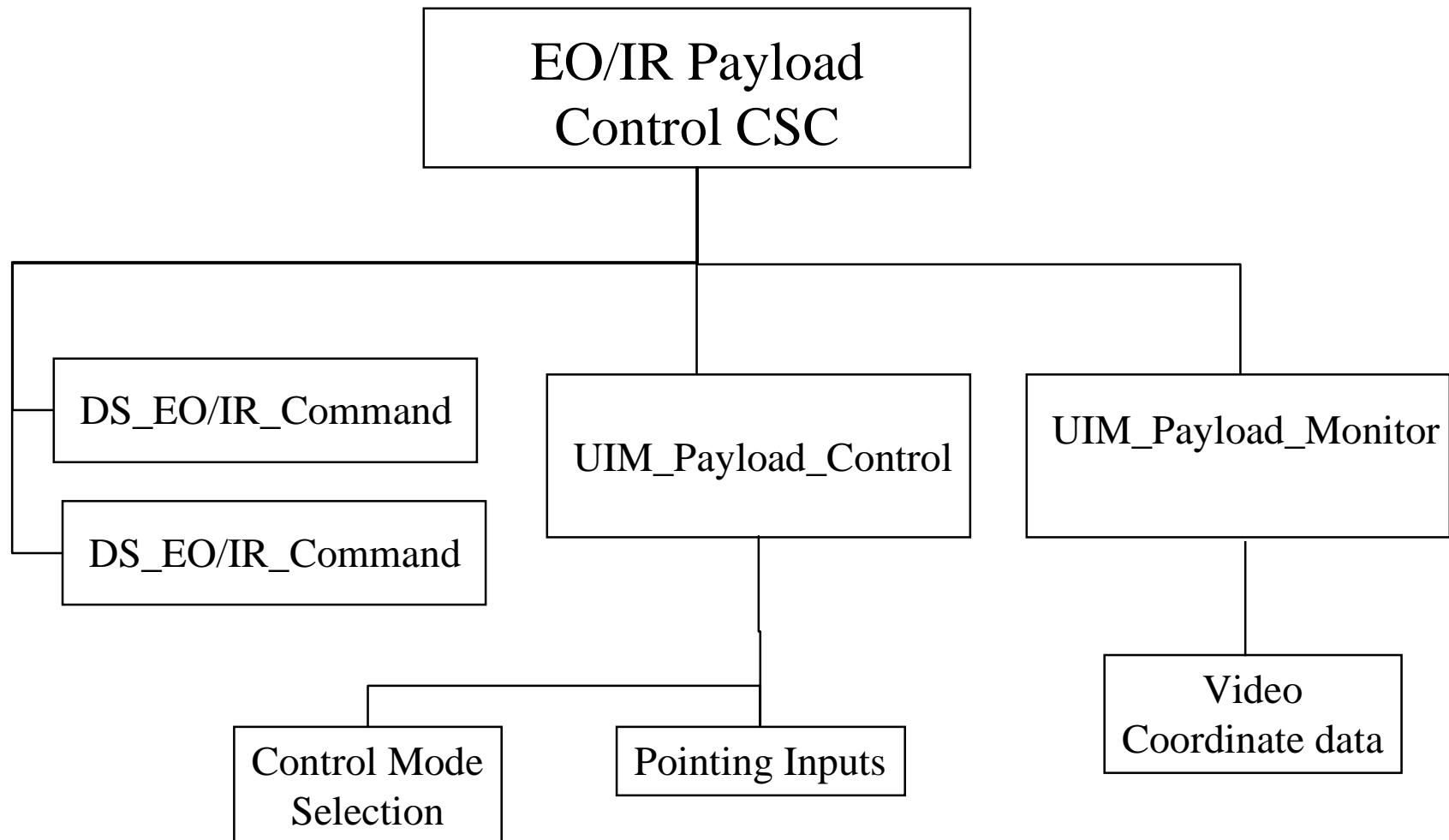
Block Diagram





EO/IR Payload Control CSC

Block Diagram





EO/IR Payload Control - Inputs/Outputs

TCS to AV Data Flows

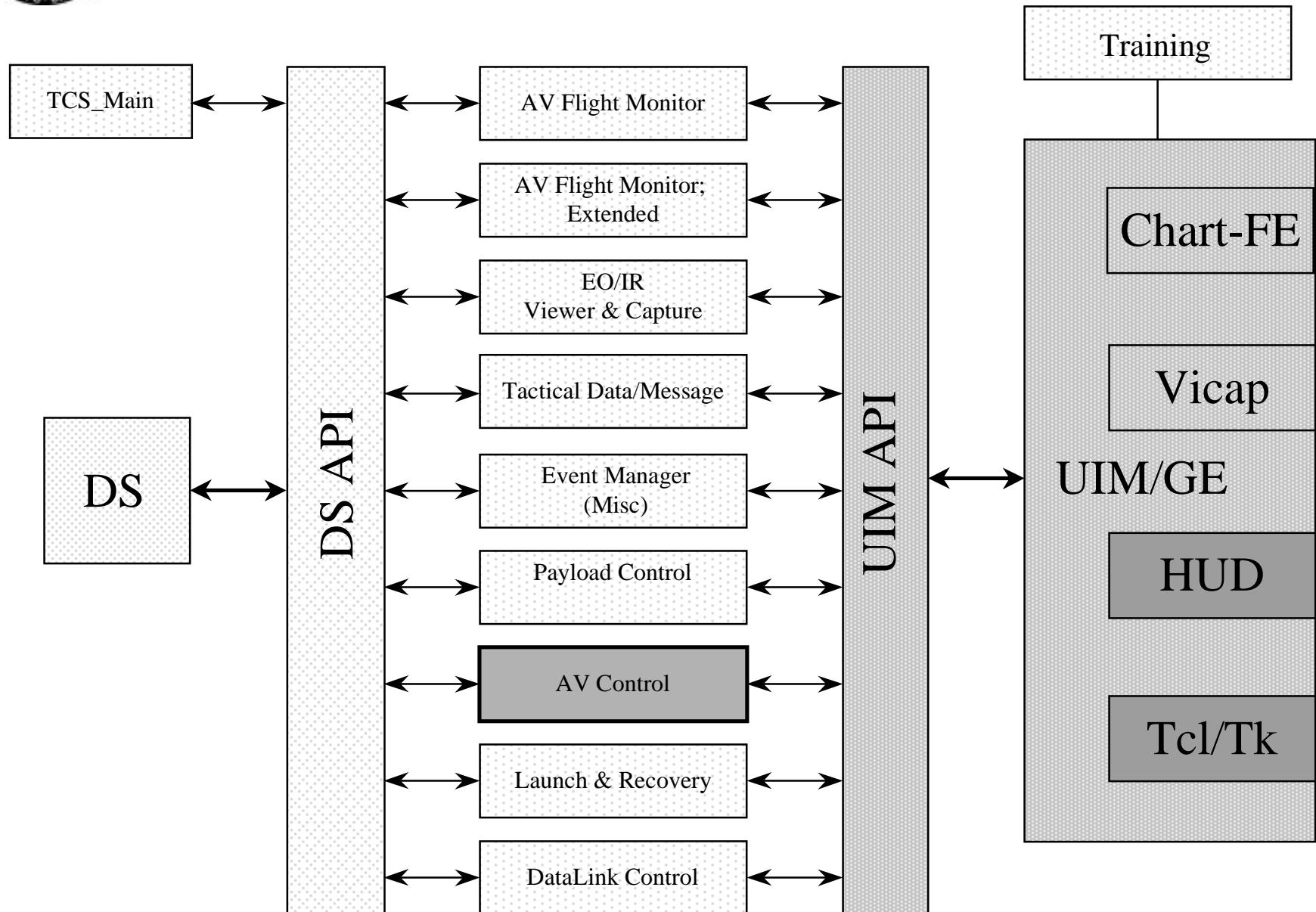
| AVSI Message | DS Bucket | UIM Object |
|--------------|--------------|---------------------|
| EOIR_Command | EOIR_Command | UIM_Payload_Control |

AV to TCS Data Flows

| AVSI Message | DS Bucket | UIM Object |
|----------------|----------------|--|
| AV_EOIR_Status | AV_EOIR_Status | UIM_Payload_Control UIM_Payload_Monitor |



CAP CSC: AV Control



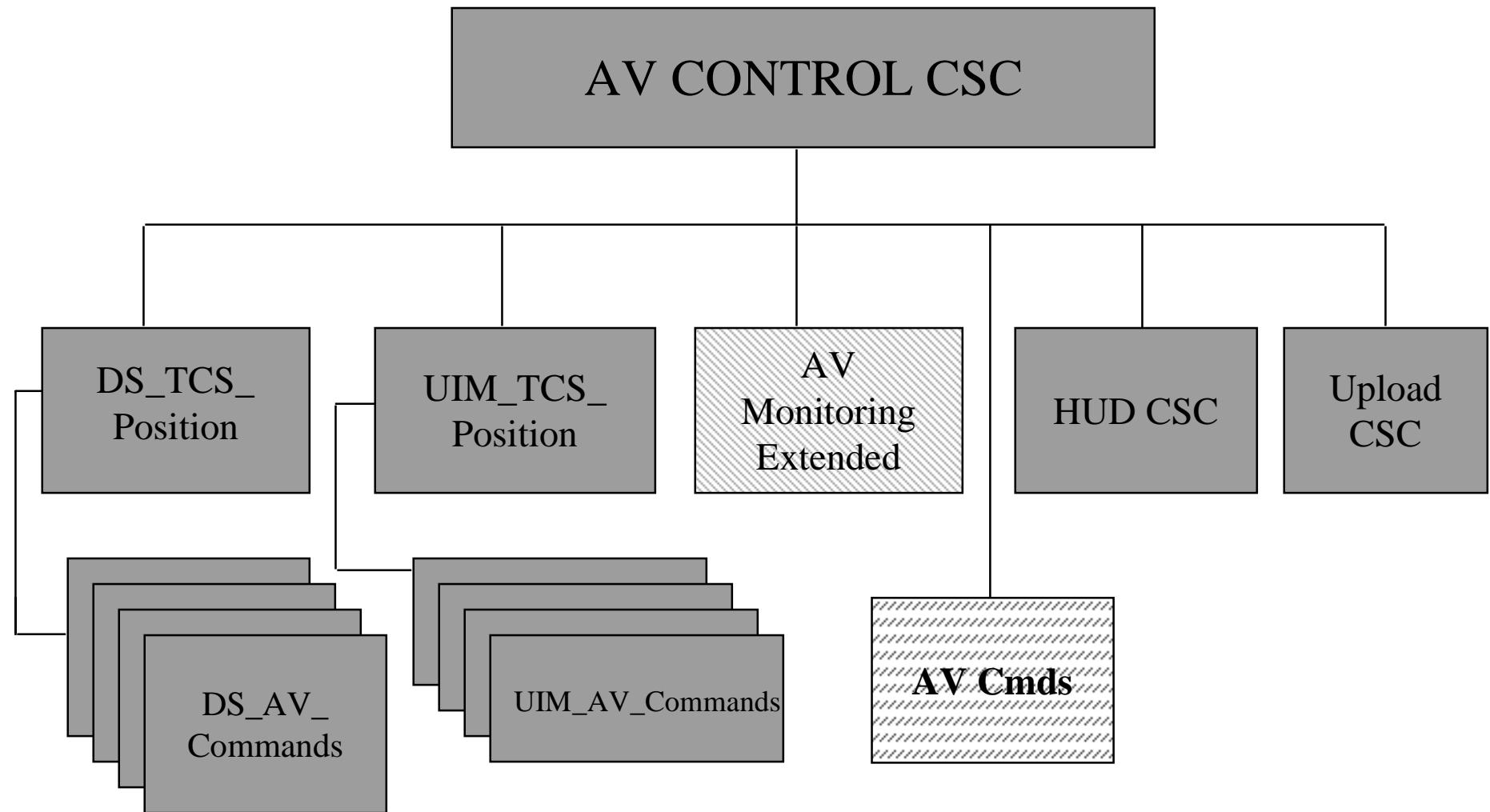


AV CONTROL CSC

- Name: AV Control
- Description:
 - Sends AV commands to DataServer(DS)
 - Gets position of TCS from either user or DII TDBM
 - Sends the position of TCS to DS
- Interfaces: DS, GE, DII TDBM



AV Control CSC Diagram





AV Control - Inputs/Outputs

From GE to DS:

| | |
|------------------|-----------------|
| UIM_TCS_Position | DS_TCS_Position |
| UIM_AV_Command | DS_AV_Command |

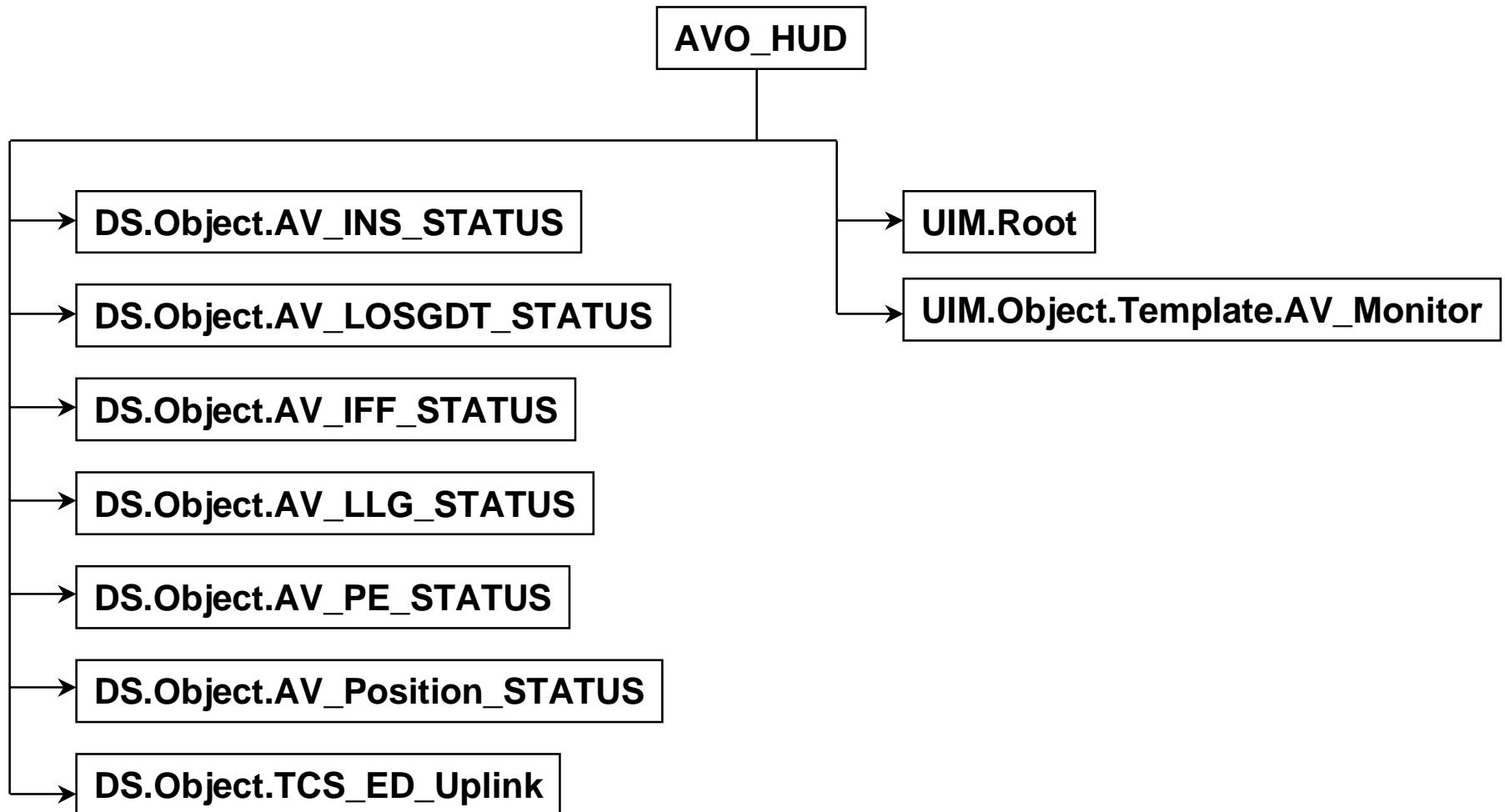


AVO HUD

- Name: Air Vehicle Operator Head-Up Display (AVO HUD)
- Description:
 - Provides timely, graphical display of critical flight status data allowing the UAV operator or pilot maximal situational awareness.
- Interfaces: DS, GE
- Note: Displays presented here may change depending upon the findings of the Joint Cockpit Display Working Group



AVO_HUD Block Diagram





AVO HUD - Inputs/Outputs

| AVSI Message | DS Bucket | Group | HCI Object | R | W |
|--|--------------------|---------|------------|---|---|
| AV IFF Status | AV_IFF_Status | Mission | AV_Monitor | Y | N |
| AV INS Status | AV_INS_Status | Mission | AV_Monitor | Y | N |
| AV Lights and Landing Gear Status | AV_LLG_Status | Mission | AV_Monitor | Y | N |
| AV Line of Sight Ground Data Terminal Status | AV_LOSGDT_Status | Mission | AV_Monitor | Y | N |
| AV Piston Engine Status | AV_PE_Status | Mission | AV_Monitor | Y | N |
| AV Position Status | AV_Position_Status | Mission | AV_Monitor | Y | N |
| TCS Environmental Data Uplink | TCS_ED_Uplink | Mission | AV_Monitor | Y | N |



Upload

Name: Upload

Description:

Receives mission list from DS.

Receives upload notification from DS (set by mission planner).

Sends flight route to DS.

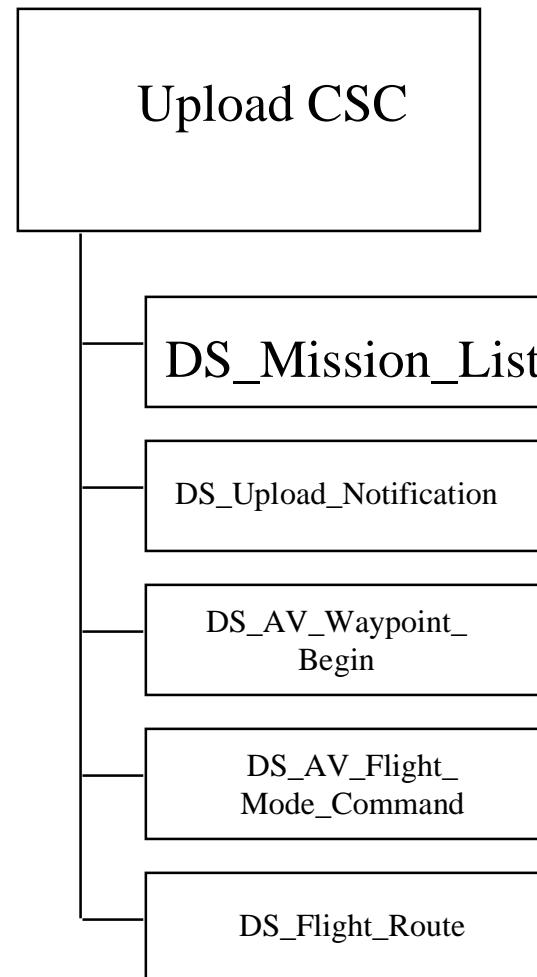
Converts mission plan to a series of AV and Payload commands.

Interfaces:

DS, Route Plan File



Upload Block Diagram





Upload - Inputs/Outputs

From DS:

DS_Mission_List

DS_Upload_Notification

To DS:

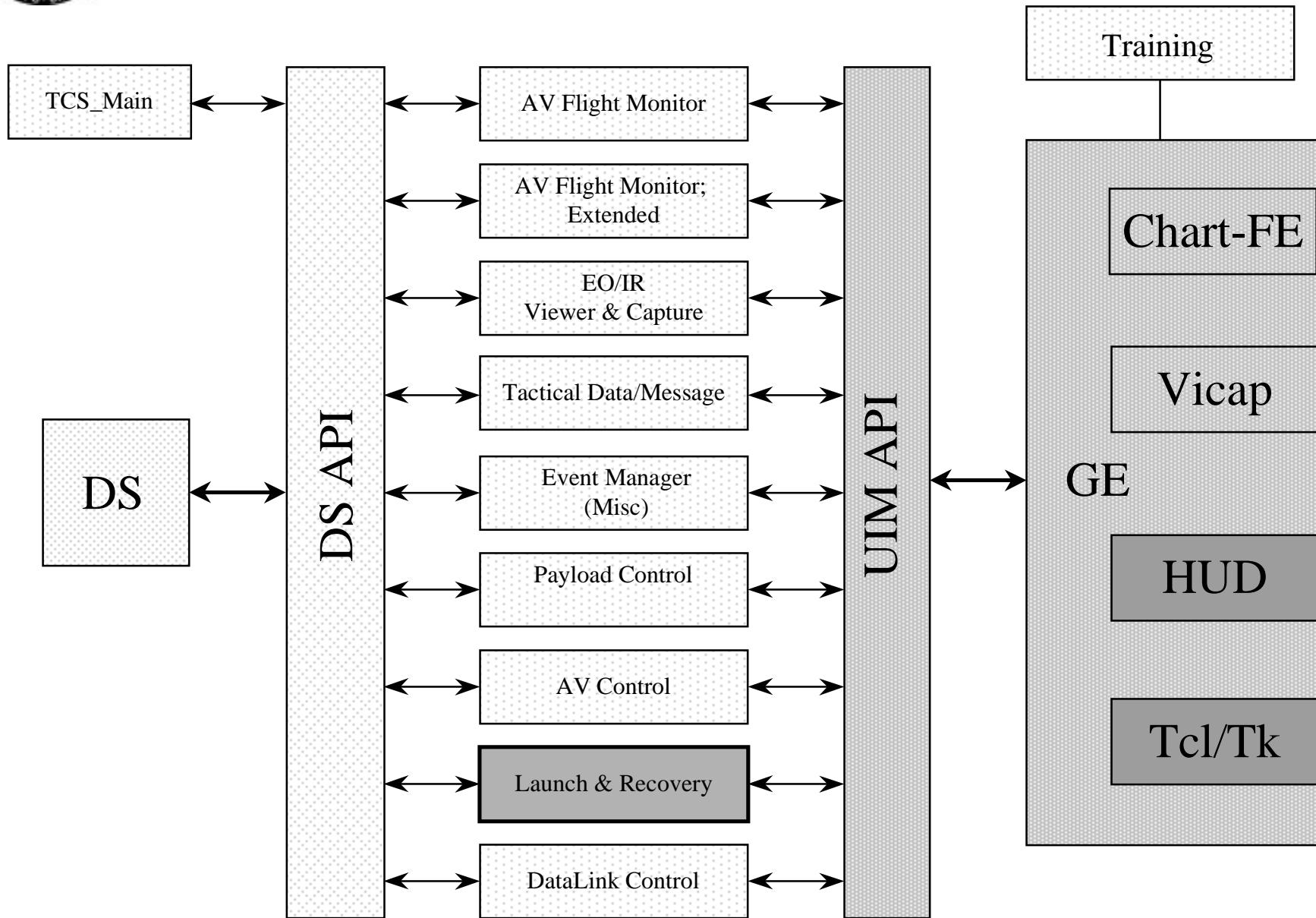
DS_AV_Waypoint_Begin

DS_AV_Flight_Mode_Command

DS_Flight_Route



CAP CSC: Launch & Recovery





Launch & Recovery CSC

Name: Launch & Recovery

Description:

Provides all additional AV commands & monitoring necessary to launch and recover a UAV.

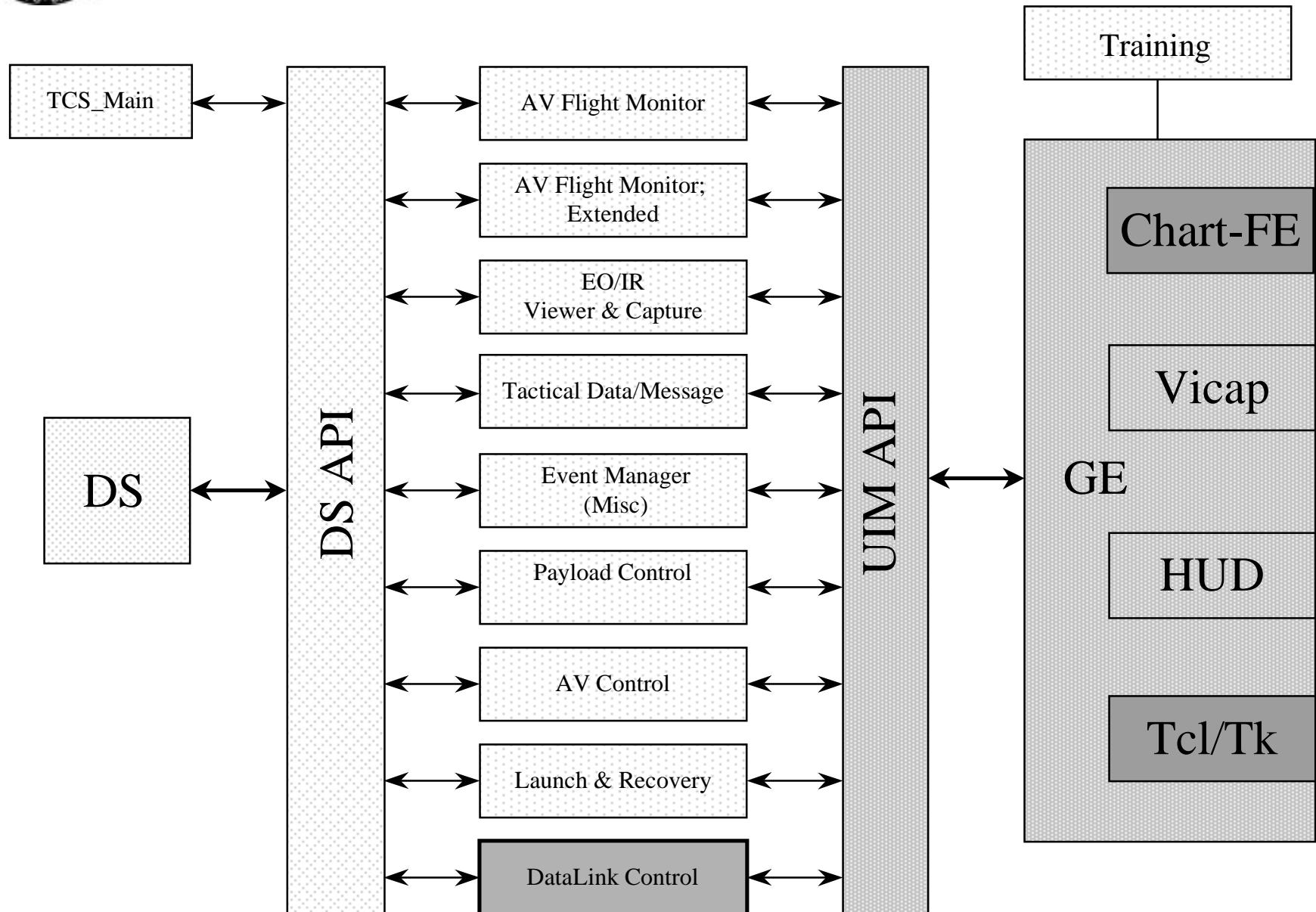
(Under Construction)

Interfaces:

DS, GE



CAP CSC: DataLink Control





Datalink Control CSC

Name: Datalink Control

Description:

Sends commands to datalink platform to DS.

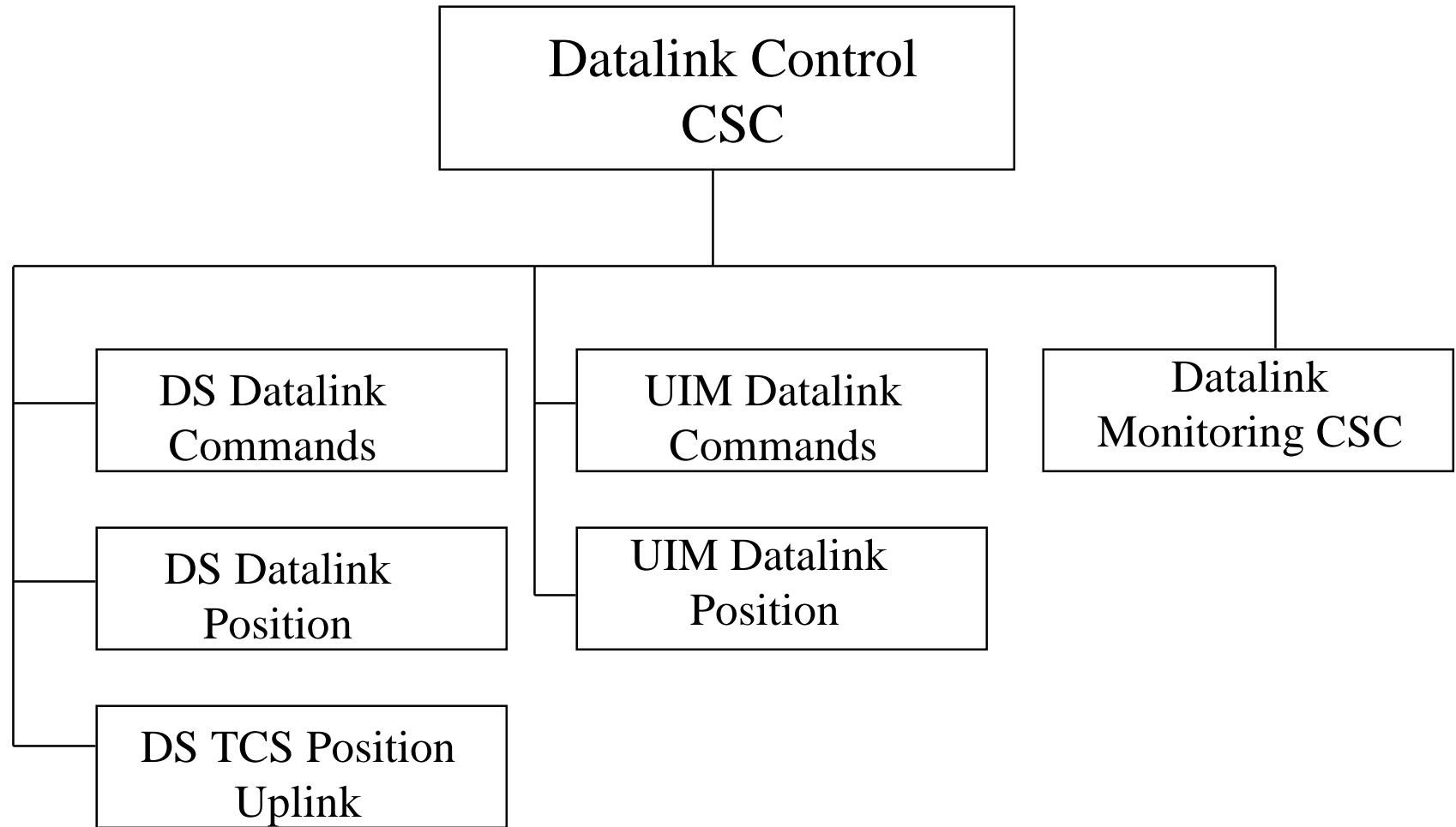
Sends the position of the datalink platform to DS.

Interfaces:

DS, GE



Datalink Control Block Diagram





Datalink Control - Inputs/Outputs

From GE to DS:

| UIM_Datalink_Commands | DS_Datalink_Commands |
|-----------------------|--|
| UIM_Datalink_Position | DS_Datalink_Position DS_TCS_Position_uplink |



Datalink Monitoring CSC

Name: Datalink Monitoring

Description:

Receives the status of the datalink platform from DS.

Displays the status of the datalink platform.

Receives the position of the datalink platform from DS.

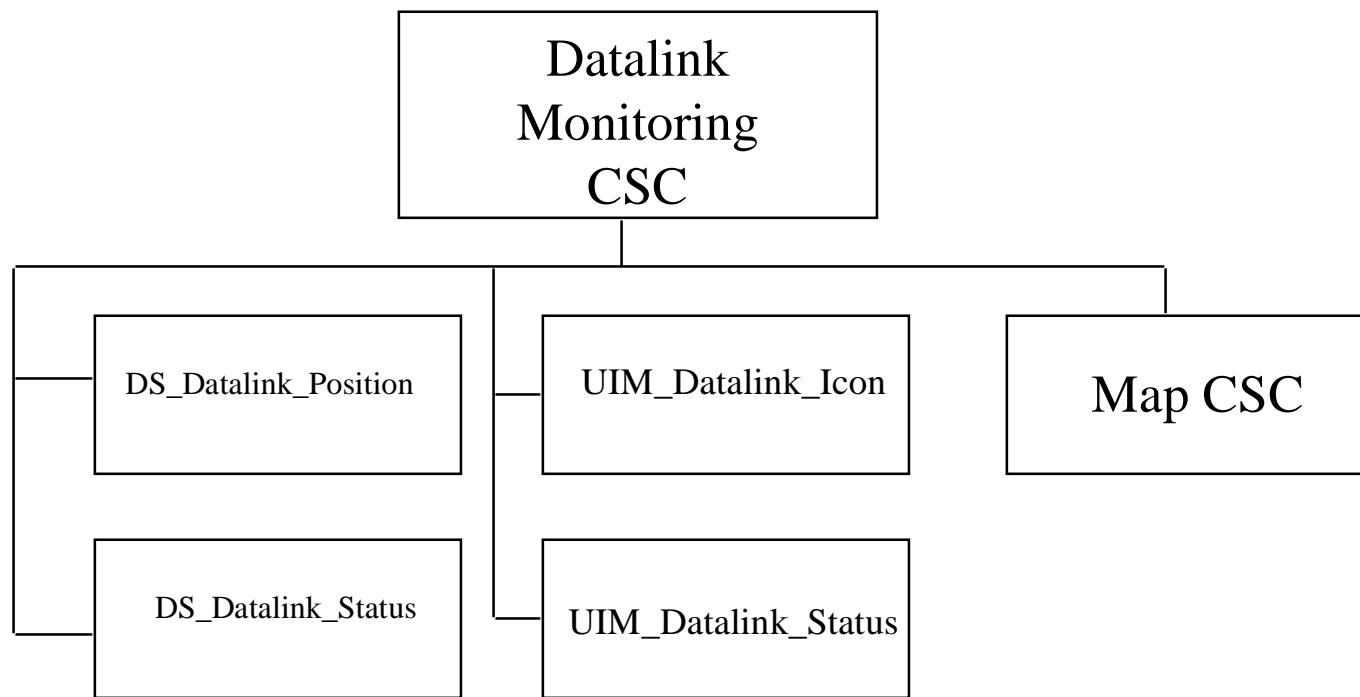
Displays the datalink icon on the map.

Interfaces:

DS, GE



Datalink Monitoring Block Diagram





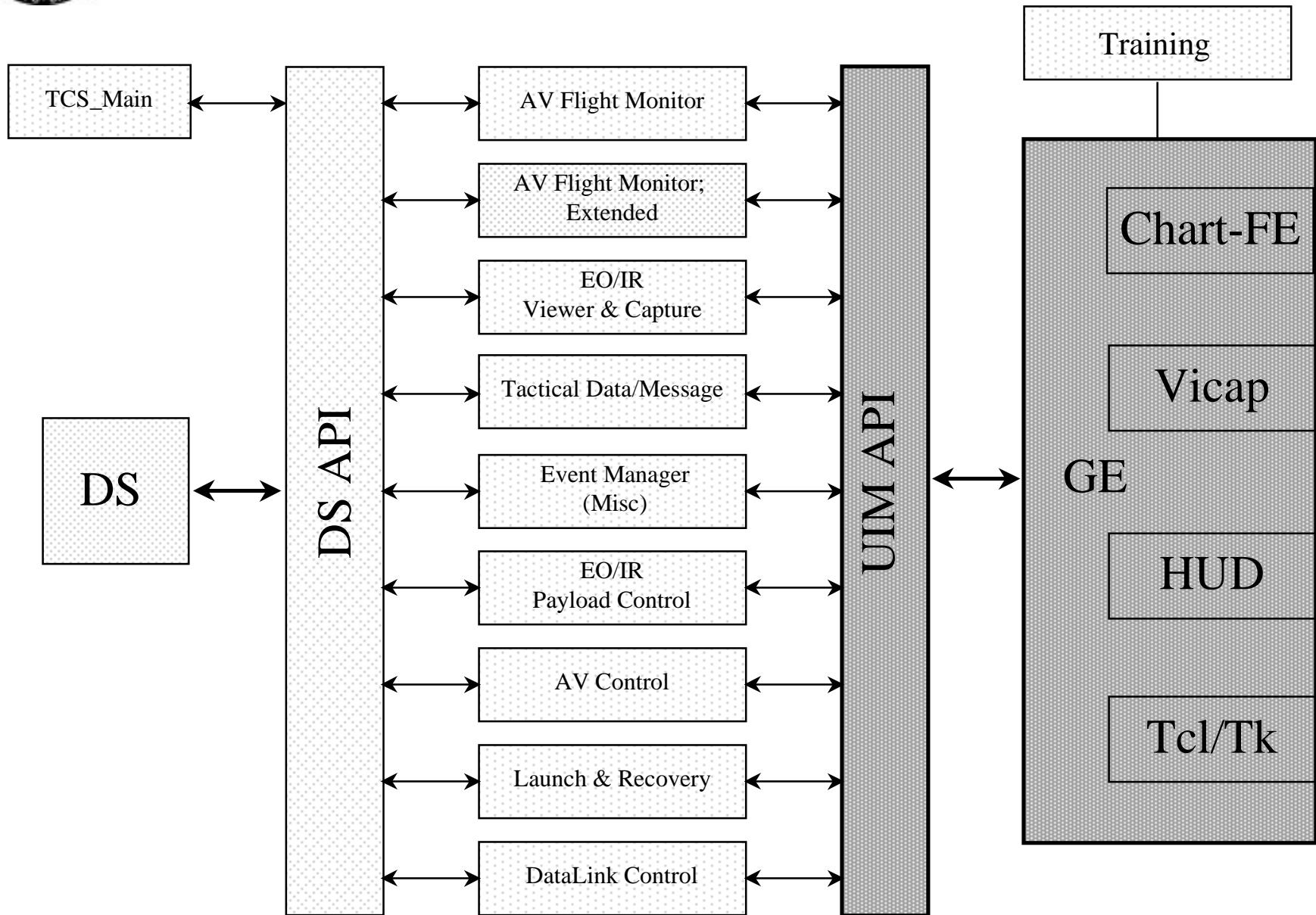
Datalink Monitoring - Inputs/Outputs

From DS to GE:

| | |
|----------------------|---------------------|
| DS_Datalink_Position | UIM_Datalink_Icon |
| DS_Datalink_Status | UIM_Datalink_Status |



CAP CSC: User Interface Manager





User Interface Manager (UIM) CSC

Name: User Interface Manager CSC

Description:

UIM CSC provides a client-server interface to a set of graphical displays. A client works with UIM objects as a collection of data values, and the mechanics of display and retrieval of those values is hidden within UIM.

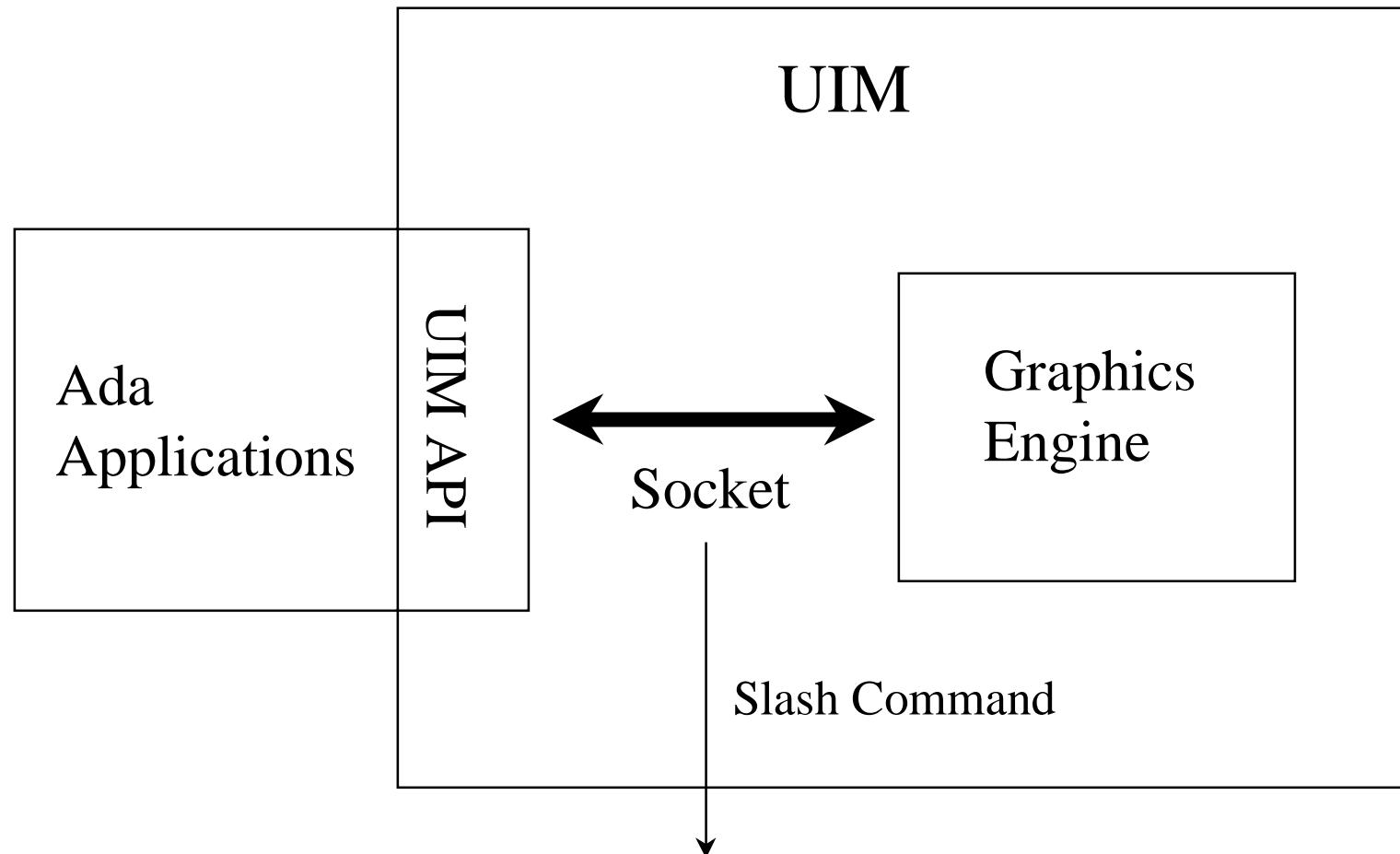
UIM's architecture is a combination of an application programming interface (API) and standalone processes.

Interfaces:

JMTK, Parallax Library, X Library, DII NITF Services



UIM Block Diagram



“av_icon_obj^10/create/symbol^2001/owner/map_obj”



UIM API SERVICES

* Set Of Procedures To Provide UIM Services To Ada Application Programs:

- CREATE Object
- DESTROY Object
- DISPLAY Object
- REMOVE Object
- SET Object Data Items
- GET Object Data Items And Events
- Set SENSITIVITY of Object Data Items
- Set Legal RANGE of Object Data Items
- ADD To List Type Object
- DELETE From List Type Object

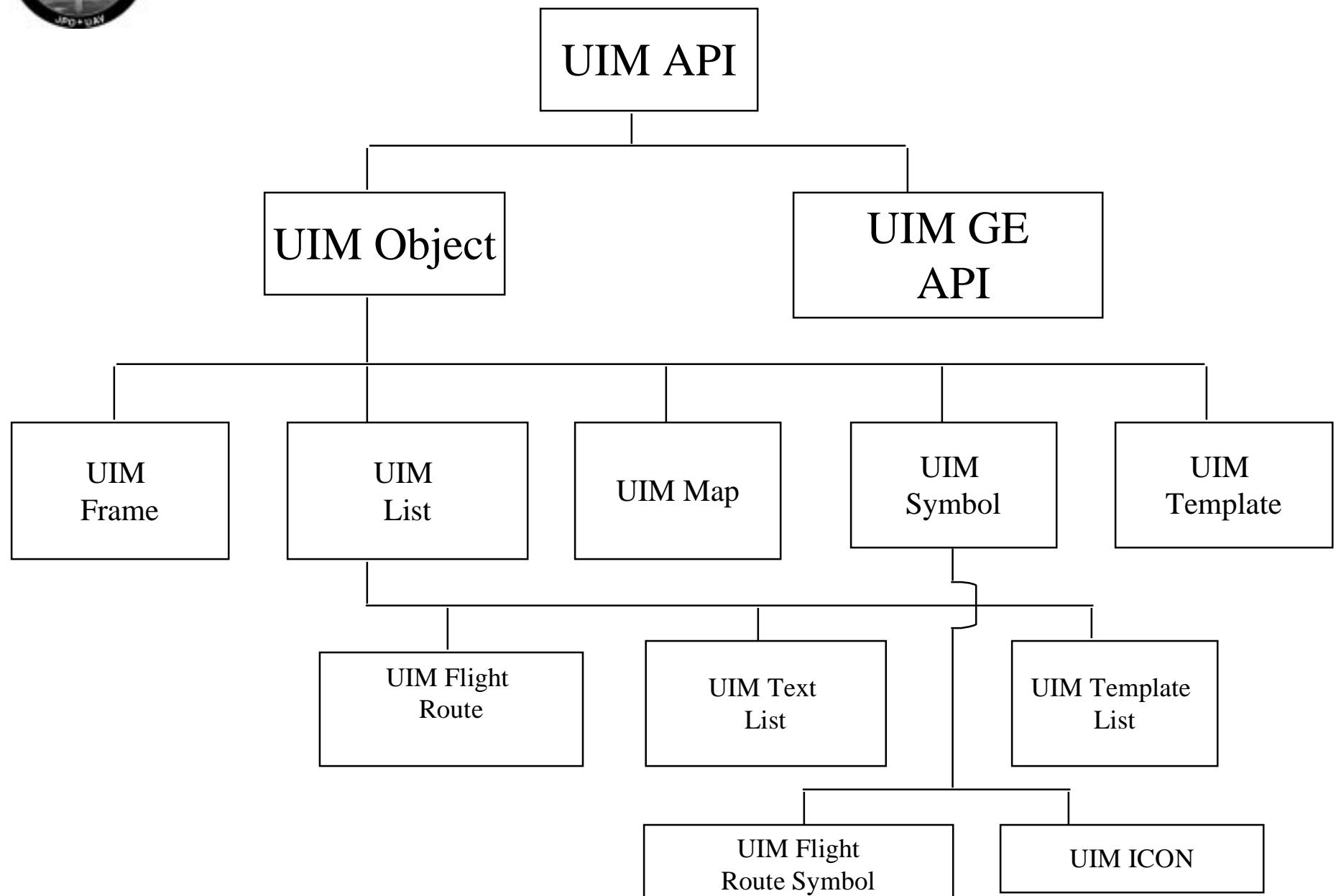
- Transform Input Parameters Into “SLASH” Command

- Provide Socket Interface Flow Control

- Provide Callback Registration And Support



UIM API BLOCK DIAGRAM



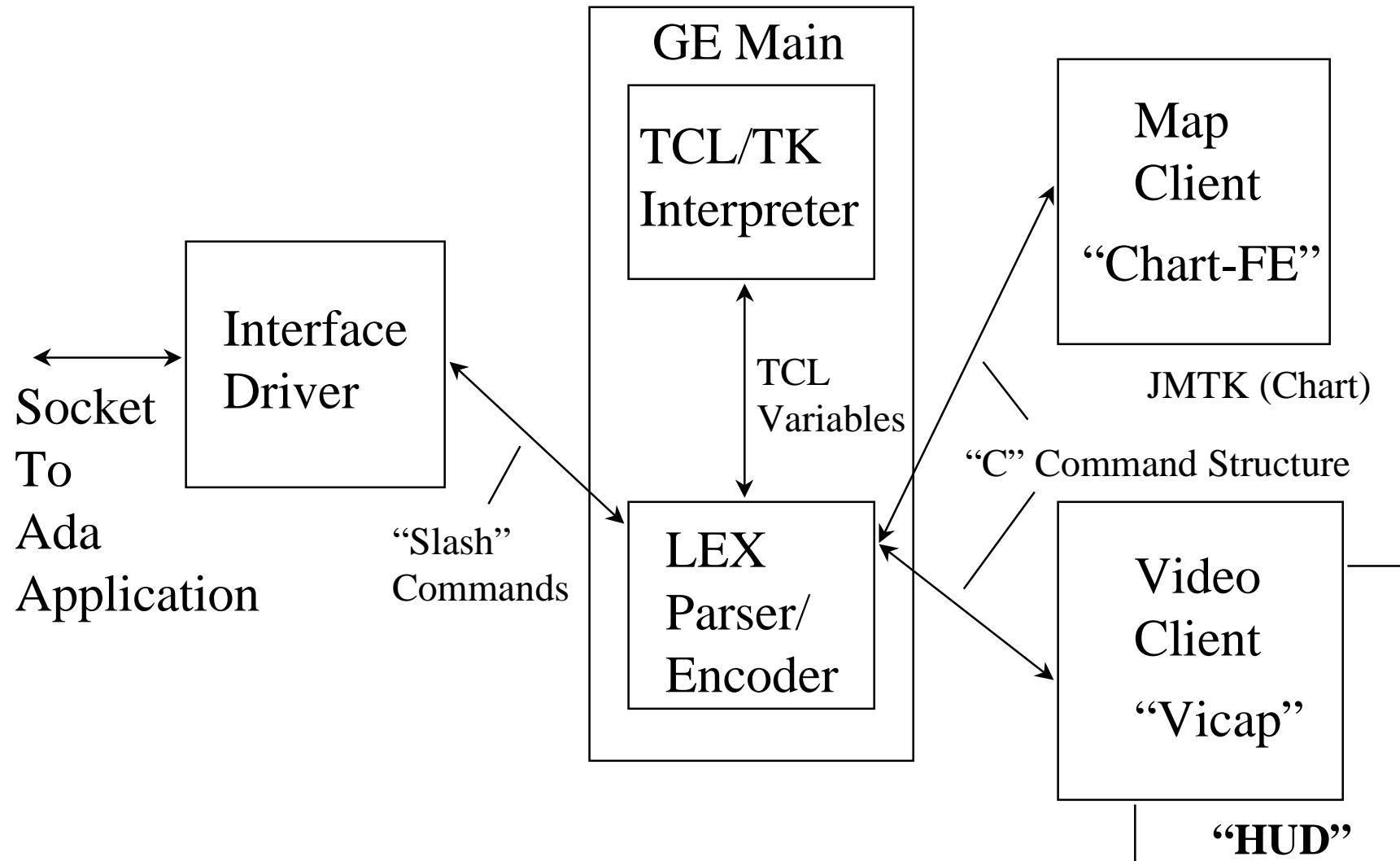


UIM API - Standard Objects

- Object
 - An abstract data type that provides graphical means of displaying data and receiving user inputs
- Frame
 - A container of objects
- List
 - A collection of similar objects
- Map
 - An object that represents a map
- Symbol
 - An object that represents a small image (i.e. icon)
- Template
 - An object that allows the user to edit data

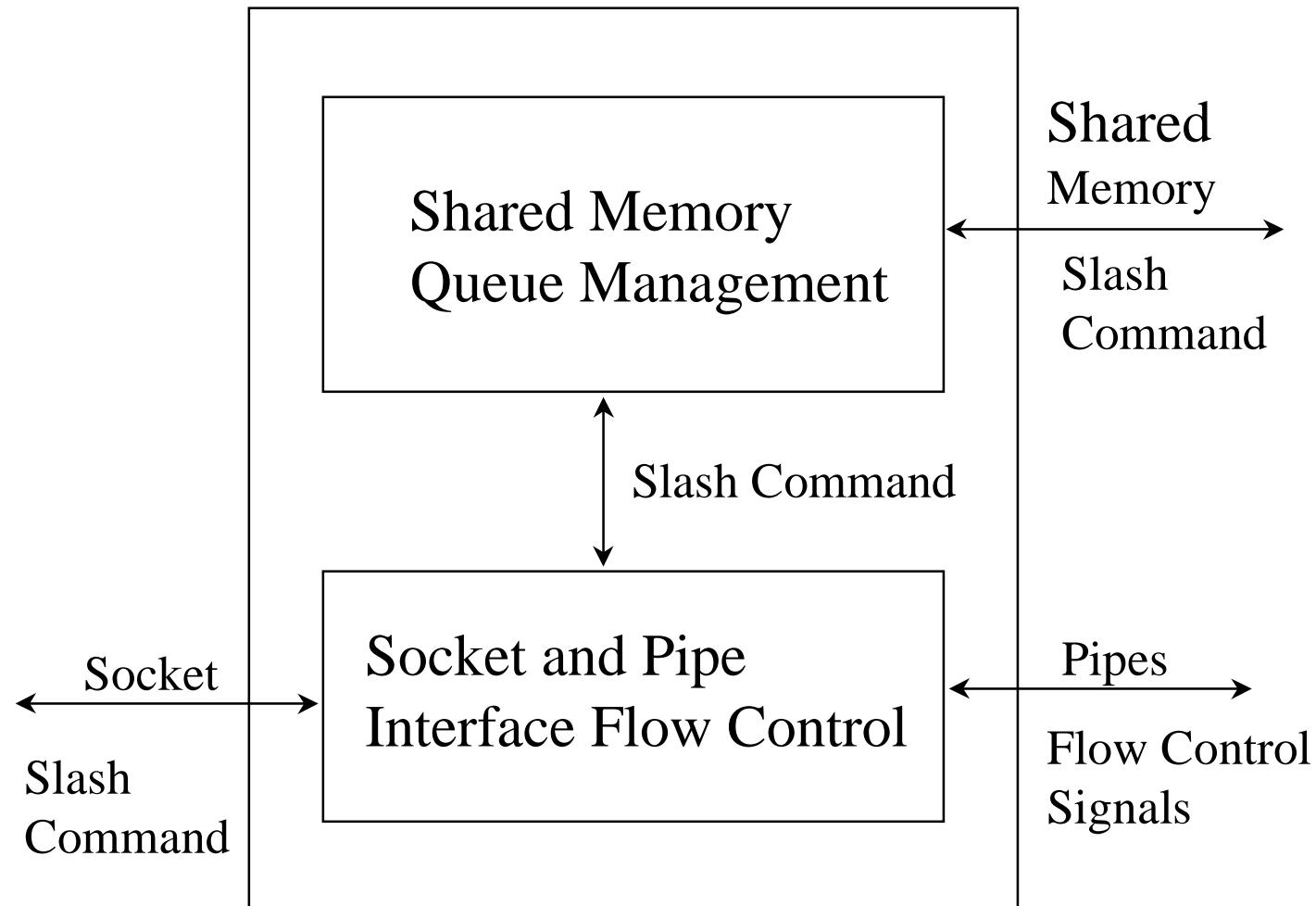


Graphics Engine (GE)



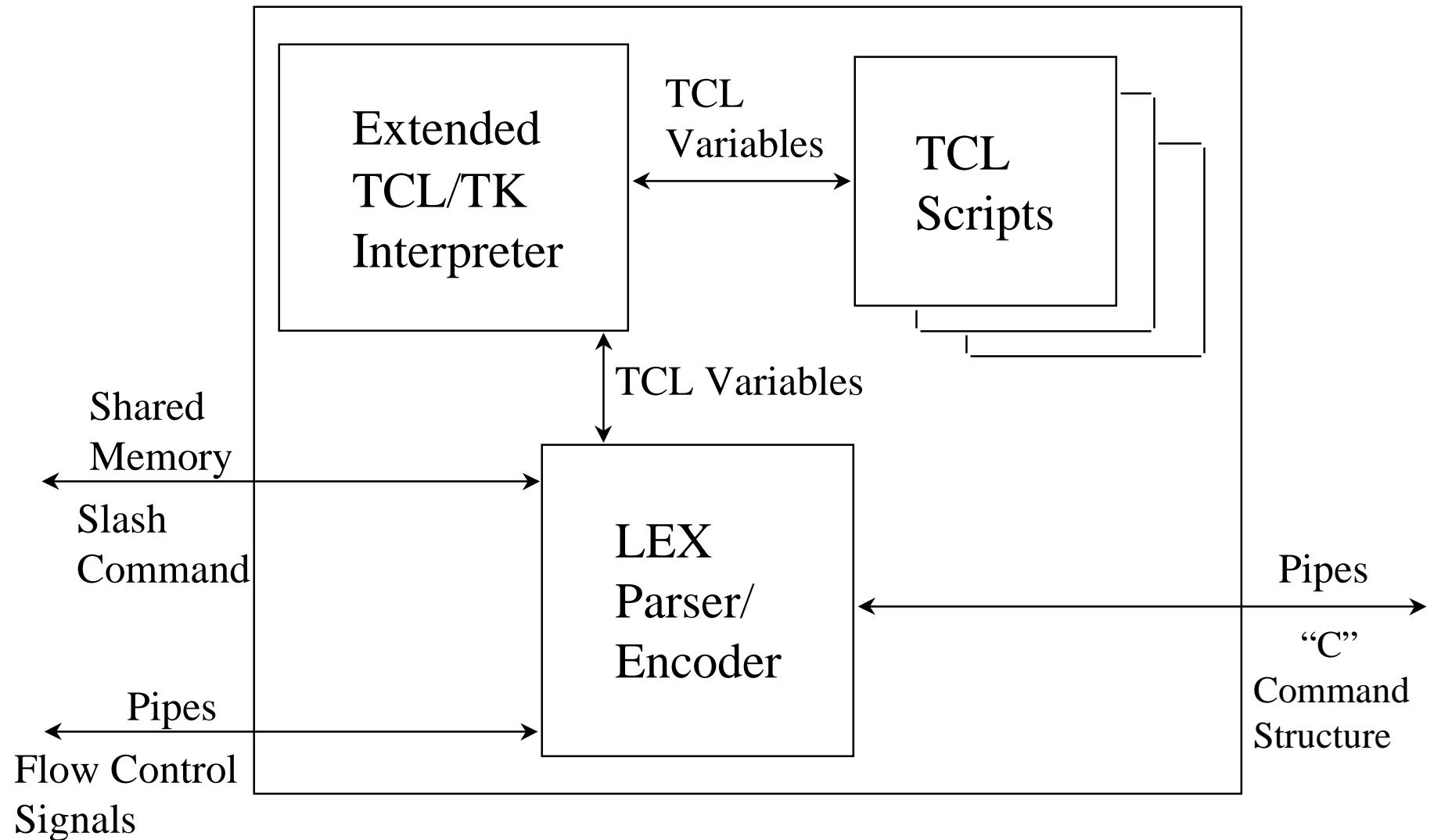


Graphics Engine - Interface Driver





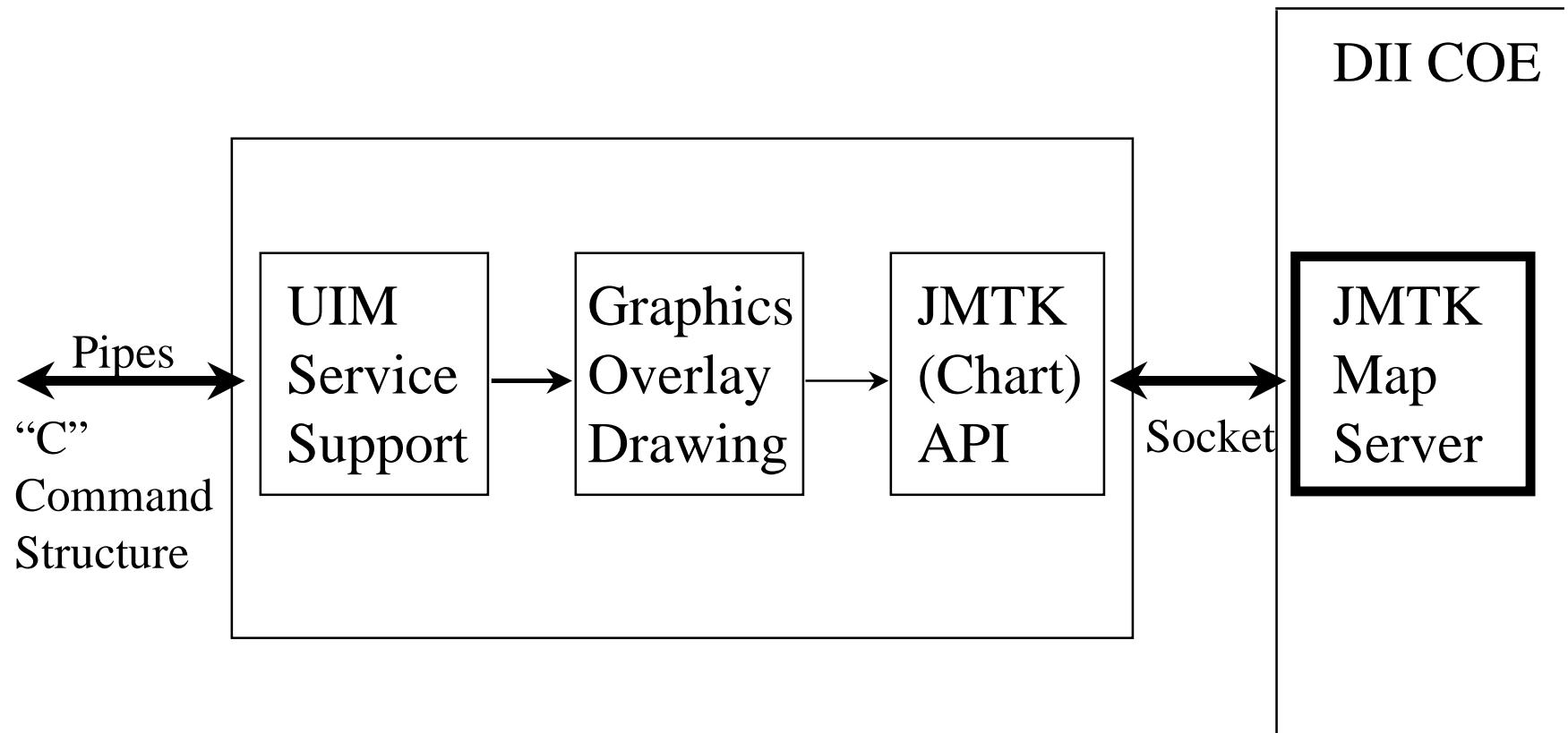
Graphics Engine - GE Main





Graphics Engine - Map Client

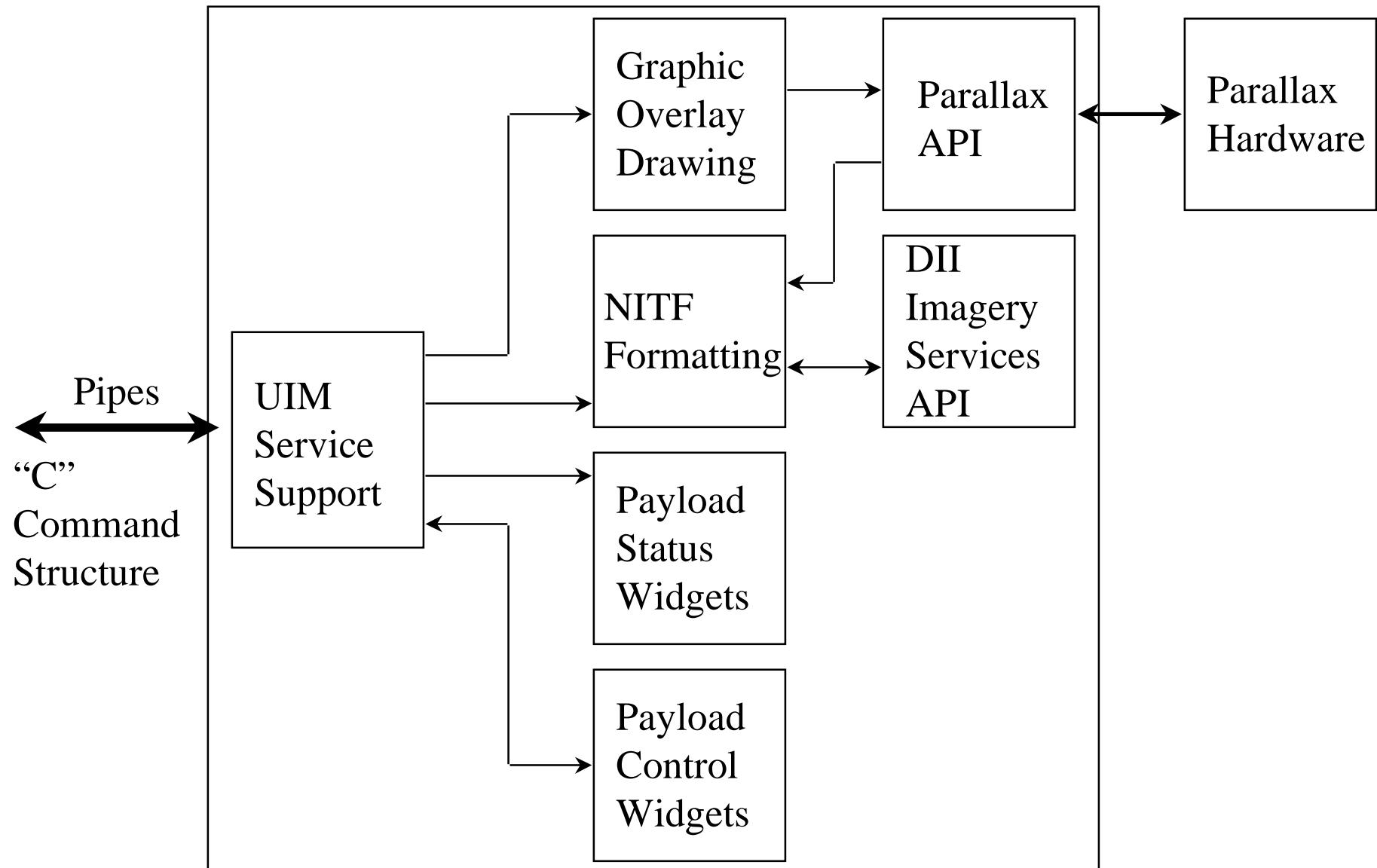
(Chart-FE)





Graphics Engine - Video Client

(Vicap/HUD)





Training Component



Training CSC

Name: Training

Description:

Provides operators with help aids for individual commands or actions

Provides a complete standalone training package.

Training “material” will be HTML based using Netscape as the viewer.

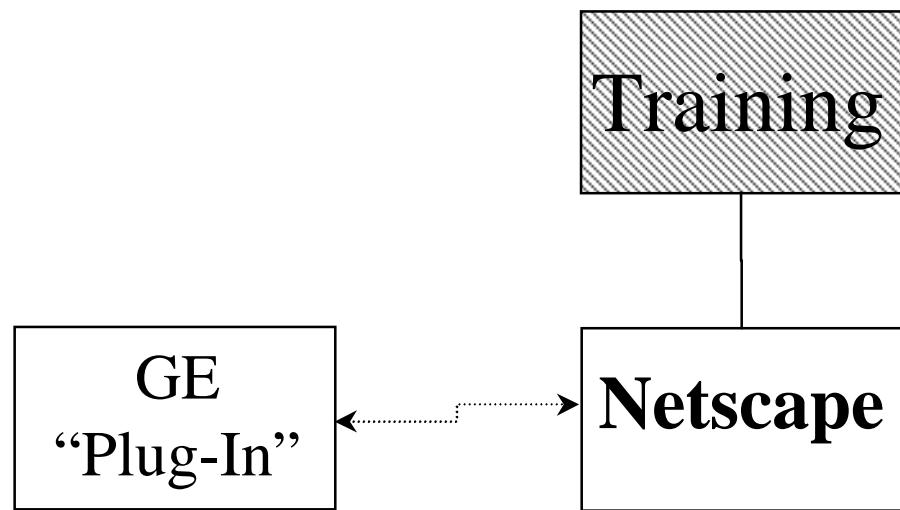
(Under Construction)

Interfaces:

GE



Training CSC Block Diagram





Detailed Discussion

Payload Display AVO HUD